

Section 1 Managing emergencies and triage

Initial management

- Stay calm.
- **Do not leave the patient unattended.**
- Have one person in charge to avoid confusion.
- **SHOUT FOR HELP.** Have one person go for help and another to get emergency equipment and supplies for example oxygen cylinder, emergency kit.
- Assess **Airway, Breathing, Circulation** and **Disability**.
- If patient is conscious, ask what happened and what symptoms he/she has.

Triage *Seeing the sickest first*

Table 1 Rapid initial assessment of a pregnant woman or girl who may be pregnant

Assess	Danger signs	Consider
Airway and breathing	<p>LOOK FOR</p> <ul style="list-style-type: none"> • cyanosis (blueness) • respiratory distress <p>EXAMINE:</p> <ul style="list-style-type: none"> • skin: pallor • lungs: wheezing or creps 	<ul style="list-style-type: none"> • severe asthma • pneumonia • heart failure • severe anaemia • malaria • diabetic ketoacidosis • anaphylaxis • pulmonary embolus • amniotic fluid embolus
Circulation (signs of shock)	<p>EXAMINE:</p> <ul style="list-style-type: none"> • skin: cool and clammy • pulse: fast (110 or more) and weak (pulse may be bounding in septic shock) • blood pressure: low (systolic less than 90 mm Hg) • urine output absent 	<ul style="list-style-type: none"> • Haemorrhage-revealed or concealed • Severe gastroenteritis • Septicaemia • Anaphylaxis • Trauma
Vaginal bleeding (early or late pregnancy or after childbirth)	<p>ASK IF:</p> <ul style="list-style-type: none"> • pregnant, length of gestation • recently given birth • placenta delivered <p>EXAMINE:</p> <ul style="list-style-type: none"> • vulva: amount of bleeding, placenta retained, obvious tears • uterus: atony • bladder: full 	<ul style="list-style-type: none"> • abortion • ectopic pregnancy • molar pregnancy • abruptio placentae • placenta praevia • ruptured uterus • atonic uterus • tears of cervix and vagina • retained placenta • inverted uterus

Section 1 Triage

Assess	Danger signs	Consider
	DO NOT DO A VAGINAL EXAM IF THERE IS A RISK OF PLACENTA PRAEVIA	
Unconscious or convulsing	ASK IF: <ul style="list-style-type: none"> • pregnant, length of gestation EXAMINE: <ul style="list-style-type: none"> • blood pressure: high (diastolic 90 mm Hg or more) • temperature: 38°C or more (may be normal in eclampsia) 	<ul style="list-style-type: none"> • Eclampsia • Malaria • Epilepsy • Tetanus • Meningitis • Poisoning
Dangerous fever	ASK IF: <ul style="list-style-type: none"> • weak, lethargic • frequent, painful urination EXAMINE: <ul style="list-style-type: none"> • temperature: 38°C or more • unconscious • neck: stiffness • lungs: shallow breathing, consolidation • abdomen: severe tenderness • vulva: purulent discharge • breasts: tender 	<ul style="list-style-type: none"> • Septicaemia • urinary tract infection • malaria • pneumonia • metritis • pelvic abscess • peritonitis • breast infection <p>• complications of abortion</p>
Severe abdominal pain	ASK IF <ul style="list-style-type: none"> • pregnant, length of gestation EXAMINE <ul style="list-style-type: none"> • blood pressure: low (systolic less than 90 mm Hg) • pulse: fast (110 or more) • temperature: 38°C or more • uterus: state of pregnancy 	<ul style="list-style-type: none"> • ovarian cyst • appendicitis • ectopic pregnancy <p>• possible term or preterm labour</p> <ul style="list-style-type: none"> • amnionitis • abruptio placenta • ruptured uterus

The mother also needs **prompt attention** if she has any of the following signs:

- BLEEDING with palpable contractions;
- ruptured membranes;
- pallor;
- weakness;
- fainting;
- severe headaches;
- blurred vision;
- vomiting;
- fever;
- respiratory distress.

The woman or girl should be sent to the front of the queue and promptly treated.

Section 1 Triage

Triage of Children

Emergency Triage Assessment and Treatment (ETAT)

Triage is the process of rapidly screening sick children and infants when they first arrive at the health facility and placing them in one of 3 groups:

- **Emergency signs- patients** who require immediate treatment to avert death. This group includes those with IMCI “Danger signs”
- **Priority signs -patients** who should be given priority within the queue so that they can be assessed and treated without delay
- **Non-urgent cases-patients** who have neither emergency or priority signs

Check for Neck / Head Trauma before treating child – do not move neck if cervical spine injury is possible

EMERGENCY SIGNS

Always assess in the following order

- **Airway**
- **Breathing**
- **Circulation**
- **Disability**

If any emergency signs present:

- give treatment(s)
- call for help
- take blood for emergency laboratory investigations (Blood glucose, Malaria screen, Hb, Blood culture if possible etc)

TABLE 3 Rapid initial assessment of a child

Assess	Emergency signs	Treatment
AIRWAY AND BREATHING	Obstructed breathing or Central Cyanosis or Severe Respiratory Distress or Oxygen Saturations <92% if available	IF FOREIGN BODY ASPIRATION <i>See Choking Protocol</i> IF NO FOREIGN BODY ASPIRATION Manage airway ie: Head tilt/chin lift unless neck trauma (jaw thrust) Neutral position (infant); Sniffing (child) Oro-pharyngeal airway Give Oxygen Ensure Child is warm

Section 1 Triage

<p>CIRCULATION</p>	<p>Cold Hands with Capillary Refill Time longer than 3 seconds AND Weak and fast pulse Low Blood pressure</p> <p>Check state of nutrition</p>	<p>Stop any bleeding Give Oxygen Ensure child is not hypothermic</p> <p>IF NOT SEVERLY MALNOURISHED Insert IV and begin giving fluids rapidly (20mls/kg) If not able to gain peripheral access use intraosseous or other method</p> <p>IF SEVERLY MALNOURISHED (visible severe wasting especially buttocks and bilateral pedal oedema)</p> <p><i>If lethargic or unconscious</i> Give IV glucose (5mls/kg 10% glucose) Insert IV line and give fluids (15mls/kg over 1 hour – Ringer-Lactate or Hartmann's and 5% Dextrose wait 2 hrs for response)</p> <p><i>If not lethargic or unconscious</i> Give Glucose orally or per NG tube Proceed immediately to full assessment and treatment</p>
<p>DISABILITY</p>	<p>Coma (U on AVPU)</p> <p>Convulsing (now)</p>	<p>Manage airway</p> <p>IF CONVULSING Give diazepam or other appropriate anticonvulsant</p> <p>IF UNCONSCIOUS If trauma suspected stabilise neck If trauma not suspected position child in left lateral position</p> <p>Give IV 5ml/Kg 10% glucose Make sure child is warm</p>

Section 1 Triage

<p>HYDRATION (child with diarrhea-)</p>	<p>Diarrhea plus any 2 of:</p> <ul style="list-style-type: none"> • Lethargy • Sunken eyes • Very Slow capillary refill (skin pinch) (>3 secs) <p>IMCI “Danger signs” of: Vomiting continuously Unable to drink</p>	<p>IF NO SEVERE MALNUTRITION Insert IV line and begin giving fluids rapidly – according to WHO Plan C</p> <p>IF SEVERE MALNUTRITION Do not insert IV Proceed immediately to full assessment and treatment</p>
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PRIORITY SIGNS - these children need prompt assessment and treatment

- Visible severe wasting
- Oedema of both feet
- Severe palmar pallor
- Any sick young infant (<2 months of age)
- Lethargy
- Continually irritable and restless
- Major burn
- Any Respiratory Distress
- An Urgent Referral Note from another facility

Note: If a child has trauma or other surgical problems, get surgical help – follow trauma guidelines.

NON-URGENT CASES – proceed with assessment and further treatment according to the child’s priority

SECTION 2 Drug and fluid administration

Fluid replacement

Oral rehydration solutions – used in gastro-enteritis to maintain electrolyte balance. Prepare by adding **1 sachet to 7 oz (210 ml)** clean water. **One ounce = 30ml**

Importance of enteral fluids:

- Best method of maintaining caloric intake is through enteral feeding
- If patient is unable to drink then pass gastric tube.
- When commencing feed fill syringe to required amount with feed, draw plunger back as far as possible and then attach syringe to tube. Kink tube and remove plunger. Allow feed to pass into stomach using gravity.
- Observe patient's colour and respiratory rate for any signs of aspiration.

- Breast milk is the best food for infants. It is always available at the correct temperature, no preparation is required and no sterilising equipment involved.
- If the infant is too ill to suck and is fed through a gastric tube, encourage mother to express milk into sterile receptacle. To encourage release of milk and ease of expression encourage mother to express whilst holding the baby. Store excess milk in a freezer. Defrost the quantity needed for 4 hours of feeding at a time.

IV fluids

IV fluids must only be used when essential and enteral feeds not available or absorbed.

Always check before use: seal is not broken, expiry date, solution is clear and free of visible particles

Dextrose/glucose solutions unless in Ringer-Lactate or Hartmann's are not appropriate for replacing fluid losses

Never infuse plain water IV: causes haemolysis and will be fatal

Always specify concentrations of dextrose and Ringer-Lactate or Hartmann's solutions to be infused.

Maintenance requirement of electrolytes:

Sodium (Na⁺) **3-4 mmol/kg/24 hour in child 150mmol/24hour in mother**

Potassium (K⁺) **2-3 mmol/kg/24 hour in child 100 mmol/24hour in mother**

Crystalloids (Ringer-Lactate or Hartmann's) are used to replace vascular compartment losses. When infused IV only ¼ remains inside the vascular compartment, the rest passes into the extra-cellular space.

All fluids should be prepared and given using an aseptic technique. It is important to observe cannula site (directly by removing dressing) for redness and swelling before each IV injection. Observe patient for pain or discomfort at drip site. If any signs of inflammation, stop fluids, reassess need for continuing IV fluid drugs and resite cannula.

Record fluid intake/hour on a fluid balance chart.

Fluids can be calculated in drops/minute as follows: (standard giving sets) 20 drops = 1ml and ml/hour divided by 3 = drops/minute.

Section 2 Fluids and drug administration

Ensure that site is kept clean

Flush cannula with 0.9% saline or Ringer-Lactate or Hartmann's 4-hourly if continuous fluids are not being given

Prescribing practice and minimising drug errors

Introduction - general

- oral administration is safer and less expensive, if tolerated
- the following antibiotics are as effective orally as IV: amoxicillin, ampicillin, chloramphenicol, ciprofloxacin, co-trimoxazole, erythromycin, flucloxacillin, fluconazole, metronidazole, sodium fusidate,
- if a drug is given down an oro/nasogastric tube, flush through
- rectal drugs are less reliably absorbed than oral drugs
- liquid formulations are better than suppositories for rectal treatment in infants

Prescribing

- use block capitals
- use approved names
- dosages should be in grams (g) milligrams (mg) or micrograms **ALWAYS WRITE MICROGRAMS IN FULL**
- volumes should be in milliliters (ml)
- avoid decimal places when possible (eg write 500mg not 0.5g) if used, prefaced by a zero (eg write 0.5ml not .5ml)
- write times using 24 hour clock
- routes of administration can be abbreviated to: IV (intravenous), IM (intramuscular), PO (orally), SC (subcutaneous) NEB (nebuliser), PR (rectally)
- 'as required' prescriptions must be specific as to how much, how often and for what purpose (indicate maximum 24 hour dose)
- 'stop dates' for short course treatments should be recorded when first prescribed

Measuring Drugs

- multiple sampling from drug vials risks introducing infection: they do not contain preservatives or antiseptic
- dilute drugs so that volumes can accurately be measured eg do not use doses <0.1ml for a 1 ml syringe
- do not forget to consider the dead space in the hub of the syringe for small volumes
- for dilutions >10 fold, use a small syringe to inject the active drug connected by a sterile 3 way tap to a larger syringe and then add diluent to the large syringe to reach desired volume

Delivery

- **MUST BE GIVEN IN AN ASEPTIC MANNER**
- give IV drugs slowly in all cases
- after injection into line (eg through a 3 way tap), use the usual rate of the IV infusion to drive the drug slowly into the patient
- if there is no background infusion, give sufficient follow-up (flush) of 0.9% saline or 5% dextrose to clear the drug from the cannula or T piece
- repeat flushes of 0.9% saline can result in excess sodium intake in infants - use 0.45% saline if possible
- flush over 2 minutes to avoid sudden surge of drug (remember the hub)

Infusions

- **MUST BE GIVEN IN AN ASEPTIC MANNER**
- adjust total 24 hour IV fluid intake

Section 2 Fluids and drug administration

- never put more drug or background IV into syringe or burette than is needed over a defined period of time
- check and chart rate of infusion and confirm this by examining amount left every hour
- Use cannula NOT butterfly needles for infusions if available
- DO NOT mix incompatible fluids IV
- do not add drugs to any line containing blood or blood products
- infusions of glucose >10%, and adrenaline, can cause problems if outside the vein
- most IV drugs can be given into an infusion containing 0.9% saline or Ringer-Lactate or Hartmann's or up to 10% glucose (exceptions include phenytoin and erythromycin)
- if using only one line wait 10 minutes between each drug infused, or separate by 1 ml of 0.9% saline or sterile water

Safe IV infusions where no burettes are available

Mark the infusion bottle with tape for each hour of fluid to be given and label each hour.

Or

Empty until only the necessary amount of fluid to be given is left in bottle

Intravenous Lines

- always place cannula aseptically and keep the site clean
- use **sterile** bungs, NOT syringes, for closing off cannula/butterfly needles between IV injections
- change giving sets every 3 or 4 days
- change the giving set after blood transfusion, or if a column of blood has entered the infusion tubing from the vein (site of potential bacterial colonization)
- always inspect the cannula tip before and whilst injecting any drug IV - never give a drug into a drip that has started to tissue - severe scarring can occur, for example from calcium solutions.
- always use luer lock connections to minimize extravasations

Sampling

- clear the dead space first (by 3x its volume)
- glucose levels cannot be accurately measured from any line through which a glucose solution is infused
- blood cultures should always be taken from a separate, fresh, venous needle or stab sample
- after sampling, flush the line - beware that repeat flushes of 0.9% saline can result in excess sodium intake in infants

Complications

- infection
 - local infection can become systemic, especially in neonates or the immunosuppressed (eg HIV)
 - if there is erythema in tissue, remove the cannula
 - if lymphangitis is present, remove cannula, take a blood culture from a separate vein and start IV antibiotics
- air embolism
 - umbilical or other central venous lines are particularly high risk
 - another source of air embolus is through the giving set, especially when pumps are used
 - always use a tap or syringe on the catheter, especially during insertion
 - if air reaches the heart it can block the circulation and cause death
- haemorrhage
 - in neonates this can occur from the umbilical stump
 - all connections must be luer locked
 - the connections to the cannula and its entry must be visualized at all times

Minimising Errors with IV infusions

- prescribe or change infusion rates as infrequently as possible
- have the minimum number of IV infusions running at the same time
- use a burette in which no more than the prescribed volume is present (especially in infants and young children, or with drugs like quinine)
- record hourly the amount given (from burette, syringe or infusion bag) and the amount left
- check the infusion site hourly to ensure fluid outside the vein has not occurred
- ensure that flushes are only used when essential and are given slowly over at least 2 minutes
- be careful with potassium solutions given IV (use enteral route when possible)
- check and double check the following:
 - is it the right drug? Check ampoules as well as box
 - is it the right concentration?
 - is shelf life within expiry date?
 - has it been constituted and diluted correctly?
 - is it for the right patient?
 - is the dose right (2 health workers ideally to check the prescription chart)
 - is it the correct syringe? (deal with one patient at a time)
 - is the IV line patent?
 - is a separate flush needed? If so has the flush been checked?
 - are sharps disposed of (including glass ampoules)?
 - has it been signed off as completed (ideally countersigned)?
 - If not received is reason given?

Intramuscular injections

- IM injections are unsafe in shock, especially with opiates
 - eg a high dose can be released once recovery of the circulation occurs
 - to avoid nerve damage, only the anterior aspect of the quadriceps muscle in the thigh is safe in infants
 - alternate between legs if multiple injections are needed
 - do not give IM injections if a bleeding tendency is present
 - draw back the plunger to ensure that the needle is not in a vein before injecting (especially adrenaline or lidocaine)
- In very poorly resourced situations the IM route might be preferred because the drug might reach the patient sooner than if the patient had to wait in a queue to have an IV sited. It also
- requires less nursing time
 - less expensive: venous cannula are often in short supply
 - as effective as IV injections in many situations

Section 4 Blood transfusion

Section 3 Blood and blood transfusion and techniques to avoid transfusion wherever possible.

Ensure the blood is compatible with the recipient, is infection free and is given safely.

Normal Hb (after the neonatal period) is around 12G/dl. WHO defines anaemia as any Hb below 11G/dl but in pregnancy haemodilution means that a figure of <10g/dl is more appropriate.

Severe anaemia in a child is Hb 5G/dl or less. Hb 5G/dl is the widely accepted level at which transfusion might be indicated and < 4G/dl if severe malnutrition. In a pregnant woman, transfusion may be considered at a Hb level of 6 – 7 G/dL taking into account other factors.

Factors other than the Hb level must be taken into account when considering transfusion:

- What is the heart rate? If rapid this will favour the decision to transfuse
- What is the respiration rate? If rapid this will favour the decision to transfuse
- Is a patient grunting? If so this will favour the decision to transfuse
- Is the patient already in circulatory collapse (shock)? **Transfusion is very urgent**

Some patients will not show any of these features, and it might then be justifiable to delay transfusion and use haematinics – iron and folic acid. Some patients may show the above features and have a Hb of more than 5G. It will also be necessary to transfuse such patients.

Who needs blood?

- **woman or girl** with obstetric emergencies eg APH, PPH
- Children with severe malaria. Usually under 2 years old
- Patients involved in major trauma or surgery
- Children with severe burns

A child's body contains 80ml blood for every kg body weight; therefore a 3 year old weighing 12kg will have 960ml blood. A pregnant **woman or girl's** body contains 100ml/Kg of blood.

During initial transfusion give 20ml/kg body weight in a child; i.e. increase the blood volume by 25% (in severe malnutrition give 15ml/Kg and watch carefully for heart failure) and in the **pregnant woman or girl give 2 units (1000 ml) with frusemide 40mg IV after each 500ml.**

The transfusion should ideally take 4 hours except in cases of shock when blood must be given as quickly as possible. Each unit of blood transfused should never take longer than 6 hours. Blood left out of the fridge longer than 6 hours should be discarded.

Section 4 Blood transfusion

A trained person must monitor the patient as frequently as possible during a transfusion (T,P,R,BP, urine output)

Blood should be warm before it is infused. This can be achieved by passing the coiled delivery tube through a bowl of lukewarm water by the patient's side (be careful of the risk from electricity at this time) or by warming the transfusion pack under a relative's clothes.

For blood there are 20 drops per ml; in changing ml per hour into drops per minute you divide by 3.

Eg a 10kg child require 10 x 20ml blood for transfusion = 200ml

200ml in 4 hours = 50ml per hour

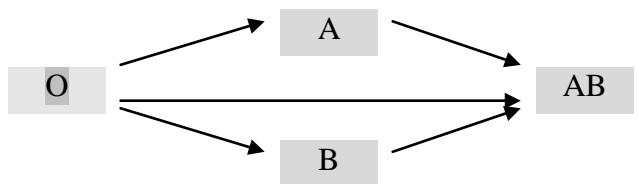
50ml per hour divided by 3 = 17 drops per minute

Any rate between 16-18 drops per minute would be acceptable for this transfusion

If the drip goes at the correct rate throughout the transfusion, you can use the **time** to know when the right amount of blood has been delivered. Eg, the 10kg child with a 500ml bag of blood up, will require only 200ml of it. If you run your transfusion at 16-18 drops per minute as calculated above, you know that the 200ml will have gone through in 4 hours. So, if your transfusion started at 2.00pm, and your drip rate stays at 16-18 drops per minute – your 200ml will have gone in at 6.00pm. **This is more accurate than guessing the amount remaining in the bag. The safest way of giving blood when there is a danger of fluid overload is by using an IV giving set with an in-line burette.**

Blood Groups

There are 4 major blood groups - A, B, AB and O. To avoid ABO incompatibility, the blood group of the donor and the receiver must be known. Blood can only be donated in the direction of the arrows:



Donors with blood group O can donate to patients with blood group A, B, AB or O

Donors with blood group A can donate to patients with blood group A or AB

Donors with blood group B can donate to patients with blood group B or AB

Donors with blood group AB can donate only to patients with blood group AB

Section 4 Blood transfusion

Rhesus negative donors can give to rhesus +ve and -ve patients

Rhesus positive donors can only give to rhesus +ve patients



Blood O negative is the universal donor blood

If blood group unknown and blood is required before a cross-match can be performed, give O Rhesus negative blood if available.

Blood Transfusion Reactions

Causes of acute complications of transfusion

Acute haemolytic transfusion reaction

- Incompatible transfused red cells react with the patient's own anti-A or anti-B antibodies or other alloantibodies (eg anti-rhesus (Rh) D) to red cell antigens. Complement can be activated and may lead to *disseminated intravascular coagulation* (DIC).
- Infusion of ABO incompatible blood almost always arises from errors in labelling sample tubes/request forms or from inadequate checks at the time of transfusion. Where red cells are mistakenly administered, there is about a 1 in 3 risk of ABO incompatibility and 10% mortality with the severest reaction seen in a group O individual receiving group A red cells.
- Non-ABO red cell antibody haemolytic reactions tend to be less severe.

Infective shock

- Bacterial contamination can be fatal.
- Acute onset of hypertension or hypotension, rigors and collapse rapidly follows the transfusion.
- Transfusion-related acute lung injury (TRALI)
- TRALI is a form of acute respiratory distress due to donor plasma containing antibodies against the patient's leukocytes.
- Transfusion is followed within 6 hours of transfusion by the development of prominent nonproductive cough, breathlessness, hypoxia and frothy sputum. Fever and rigors may be present.
- CXR if available shows multiple perihilar nodules with infiltration of the lower lung fields.

Fluid overload

- This occurs when too much fluid is transfused or too quickly, leading to *pulmonary oedema* and *acute respiratory failure*.
- Patients at particular risk are those with severe or chronic anaemia, severe malnutrition and who have normal blood volumes (that is not bleeding) and those with symptoms of *cardiac failure* prior to transfusion.

Section 4 Blood transfusion

- These patients should receive packed cells rather than whole blood via slow transfusion, with diuretics if required.

Non-haemolytic febrile reactions to transfusion of platelets and red cells

- Fevers ($>1^{\circ}\text{C}$ above baseline) and rigors may develop during transfusion due to patient antibodies to transfused white cells.
- This type of reaction affects 1-2% of patients.
- Multiparous women and those who have received multiple previous transfusions are most at risk. Reactions are unpleasant but not life-threatening. Usually symptoms develop towards the end of a transfusion or in the subsequent two hours. Most febrile reactions can be managed by slowing or stopping the transfusion and giving paracetamol.
- Severe allergic reaction or anaphylaxis
- Allergic reactions occur when patients have antibodies that react with proteins in transfused blood components.
- Anaphylaxis occurs where an individual has previously been sensitised to an allergen present in the blood and on re-exposure, releases immunoglobulin E (IgE), or IgG, antibodies. Patients with anaphylaxis become acutely dyspnoeic due to bronchospasm and laryngeal oedema and may complain of chest pain, abdominal pain and nausea.
- Urticaria and itching are common within minutes of starting a transfusion.
- Symptoms are usually controlled by slowing the transfusion and giving antihistamine and the transfusion may be continued if there is no progression at 30 minutes.
- Pre-treatment with an antihistamine should be given when a patient has experienced repeated allergic reactions to transfusion.
- Presentation
- Symptoms or signs may occur after only 5-10 ml of transfusion of incompatible blood so patients should be **observed very closely at the start of each blood unit transfused**.

Symptoms:

- Feeling of apprehension or 'something wrong'
- Flushing
- Chills
- Pain at the vene-puncture site
- Muscle aches
- Nausea
- Pain in the abdomen, loins or chest.
- Shortness of breath

Signs:

- Fever (rise of 1.5°C or more) and rigors
- Hypotension or hypertension
- Tachycardia
- Respiratory distress
- Oozing from wounds or puncture sites
- *Haemoglobinaemia*
- *Haemoglobinuria*

Investigations and management

- Where a serious acute transfusion reaction is suspected, **stop the transfusion** and take down the donor blood bag and giving set and send back to the blood bank with notification of event.
- To detect a haemolytic reaction, send post-transfusion blood (for FBC and clotting, repeat type and crossmatch, antibody screen and direct Coombs' test) and urine

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specimen (for detection of urinary haemoglobinuria: if available) from the transfusion recipient.

- Where bacterial contamination is suspected, send blood cultures from patient and bag remnants.
- If the patient is dyspnoeic, obtain CXR if possible and check for fluid overload and pulmonary oedema.

Type of reaction	Investigation findings
Acute haemolytic reactions	<ul style="list-style-type: none"> • Visual inspection of centrifuged plasma - pink-red discolouration (haemoglobinaemia) where significant intravascular haemolysis. • Visual inspection of centrifuged urine - red discolouration due to haemoglobinuria. • Retype donor and recipient red blood cells (RBCs) - discrepancy suggests that the transfusion has been mismatched and blood samples mixed up. • Direct Antiglobulin (Coombs) Test (DAT) - ABO-related acute transfusion reactions usually cause a positive DAT test. • Evidence of increased RBC destruction, eg fall in Hb and/or rise in bilirubin. • May be evidence of DIC. • Negative blood cultures.
Febrile non-haemolytic reactions	<ul style="list-style-type: none"> • Visual inspection of recipient's plasma and urine is normal. • Retyping shows no incompatibility and negative DAT test.
Allergic and anaphylactic reactions	<ul style="list-style-type: none"> • Urticaria, itching, dyspnea (see chapter 2.7.C for symptoms and signs of anaphylaxis)
TRALI	<ul style="list-style-type: none"> • Pulse oximeter shows hypoxaemia. • CXR (if available) - bilateral lung infiltrates. • FBC frequently shows low white blood cell and high eosinophil count
Transfusion transmitted bacterial infection	<ul style="list-style-type: none"> • Blood cultures positive and congruent for both donor and recipient blood.

Management

- Where the only feature is a rise in temperature of $<1.5^{\circ}\text{C}$ from baseline or urticaria, recheck that the correct blood is being transfused, give paracetamol and antihistamine, reset the transfusion at a slower rate and observe more frequently.

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Whilst fever or rigors are not uncommon in response to a transfusion and may represent a non-haemolytic febrile reaction, they may also be the first sign of a severe adverse reaction.

Where the reaction is more severe:

- Stop the transfusion and call a doctor urgently to review the patient.
- Vital signs (temp, BP, pulse, respiratory rate, O₂ saturation levels) and respiratory status (dyspnoea, tachypnoea, wheeze and cyanosis) should be checked and recorded. Look for heart failure (basal lung crepitations, enlarged liver)
- Check the patient's identity and recheck against details on blood unit and compatibility label or tag.

Initial management where *ABO incompatibility* is suspected is to:

- Take down blood bag AND giving set with blood in it
- Keep the intravenous (IV) line open with 0.9% saline or Ringer-Lactate or Hartmann's.
- Give oxygen and fluid support.
- Monitor urine output, usually following catheterisation. Maintain urine output at more than 100 ml/hour, giving furosemide if this falls.
- Consider inotrope support if hypotension is prolonged.
- Treat DIC by giving fresh new blood fully matched to recipient
- Inform the hospital transfusion department immediately.

Where *another haemolytic reaction or bacterial infection of blood unit* is suspected:

- Send haematological and microbiological investigations as outlined above.
- General supportive management is as for ABO incompatibility.
- Start broad-spectrum IV antibiotics if bacterial infection is considered likely.

Where *anaphylaxis or severe allergic reaction* is suspected:

- Follow anaphylaxis protocols for women and children (see chapters 2.7.C and 5.1.B).

Where *TRALI* is suspected:

- Give high-concentration oxygen, IV fluids and inotropes (as for acute respiratory distress syndrome).
- Ventilation may be urgently required - discuss with anaesthetist.
- TRALI improves over two to four days in over 80% cases with adequate management and respiratory support.

Where *fluid overload* is suspected:

- Give furosemide IV and high-concentration oxygen.

SECTION 4 Pain management

Paracetamol +/-
Aspirin +/-
Non-steroidal anti-
inflammatory drugs (NSAIDs)

Step 1

Morphine for moderate
to severe pain
+/- paracetamol or
NSAIDs or both
+/- Adjuvants**

Step 2

* An adjuvant is another drug (eg steroid or anxiolytic) or type of treatment (eg TENS or radiotherapy) which can relieve pain

Local anaesthetics – infiltrated: Lidocaine 0.5 to 2%

- used for rapid and intense sensory nerve block
- onset of action is within 2 minutes MUST NOT DO PROCEDURE UNTIL TAKES EFFECT
- effective for up to 2 hours
- maximum dose given locally 3 mg/kg (7mg/Kg with 1 in 200,000 adrenaline)
- safest is to use 0.5%
- 3mg/kg of 1%, up to a maximum of 200mg not more than 4 hourly, nothing about increased dose with adrenaline

DO NOT use local anaesthetic containing adrenaline in areas served by an end artery, eg finger, toe, penis. Tissue necrosis will occur.

If the procedure requires a small surface to be anaesthetized or in the pregnant woman or girl requires less than 40 mL of 0.5% lidocaine: adrenaline is not necessary.

Advantages of adding adrenaline:

- less blood loss
- longer effect of anaesthetic (usually 1–2 hours);
- less risk of toxicity because of slower absorption into the general circulation.

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The concentration of adrenaline to use is 1:200 000 (5 micrograms/mL). In children maximum dose of adrenaline is 5 micrograms/kg.

Note: It is critical to measure adrenaline carefully and accurately using a 1 ml syringe. Mixtures must be prepared observing strict infection prevention practices.

Table 4 Preparing 0.5% lidocaine solutions containing 1 in 200 000 adrenaline

Desired Amount of Local Anaesthetic Needed	0.9% Saline	Lidocaine 1%	Adrenaline 1:1 000
20 mL	10 mL	10 mL	0.1 mL
40 mL	20 mL	20 mL	0.2 mL
100 mL	50 mL	50 mL	0.5 mL
200 mL	100 mL	100 mL	1.0 mL

COMPLICATIONS OF LOCAL ANAESTHESIA

Prevention of complications

- If **more than 40 mL of 0.5% lidocaine is to be used**, add adrenaline as above. Procedures that may require more than 40 mL of 0.5% lidocaine are Caesarean Section or repair of extensive perineal tears.
- Use the lowest effective dose.
- Inject slowly.
- Avoid accidental injection into a vessel. There are three ways of doing this:
- moving needle technique (preferred for tissue infiltration): the needle is constantly in motion while injecting, this makes it impossible for a substantial amount of solution to enter a vessel
- plunger withdrawal technique (preferred when considerable amounts are injected into one site): the syringe plunger is withdrawn before injecting, if blood appears the needle is repositioned and attempted again
- syringe withdrawal technique: the needle is inserted and the anaesthetic is injected as the syringe is being withdrawn.

Symptoms and signs of lidocaine allergy and toxicity

Allergy: Shock, redness of skin, skin rash/hives, bronchospasm, vomiting, serum sickness

Management of lidocaine toxicity

Section 4 Pain management

Mild Toxicity	Severe Toxicity	Life-Threatening Toxicity (very rare)
<ul style="list-style-type: none"> • Numbness of lips and tongue • Metallic taste in mouth • Dizziness/lightheadedness • Ringing in ears • Difficulty in focusing eyes 	<ul style="list-style-type: none"> • Sleepiness • Disorientation • Muscle twitching and shivering • Slurred speech 	<ul style="list-style-type: none"> • Tonic-clonic convulsions • Respiratory depression or arrest • Cardiac depression or arrest

- direct intra-arterial or IV injection of even a small amount may result in cardiac arrhythmias and convulsions
- resuscitative facilities and skills should be present
- can be absorbed through mucous membranes in sufficient concentration to be toxic

Immediately stop injecting and prepare to treat severe and life-threatening side effects.

If symptoms and signs of mild toxicity are observed wait a few minutes to see if the symptoms subside. Check vital signs and talk to the patient. Continue the procedure if possible.

Adrenaline Toxicity

Restlessness, sweating, hypertension, cerebral haemorrhage, rapid heart rate, cardiac arrest

**Non-Opiate Analgesics
Paracetamol**

- the most widely used analgesic and anti-pyretic
- does not cause respiratory depression
- dangerous in overdose

Non-steroidal anti-inflammatory drugs (NSAID)

- anti-inflammatory, anti-pyretic drug with moderate analgesic properties
- less well tolerated than Paracetamol causing gastric irritation, platelet disorders and bronchospasm
- should be avoided with gastric ulceration, platelet abnormalities, and significant asthma
- especially useful for post-traumatic pain because of anti-inflammatory effect
- given by mouth or by rectal administration (for example diclofenac)

Caution: use in 3rd trimester of pregnancy may close the ductus arteriosus and predispose to pulmonary hypertension of the newborn. It may also delay the onset and progress of labour

Opiate Analgesics

Morphine

- in appropriate dose, analgesia occurs without loss of consciousness
- in single doses has minimal haemodynamic effect in a supine patient with normal circulating volume
- in hypovolaemic patients it will contribute to hypotension
- monitor cardiovascular status
- have IV fluid bolus of 0.9% Ringer-Lactate or Hartmann's ready (20ml/kg in a child and 500ml to 1 litre in a pregnant woman or girl)
- opiates produce a dose-dependent depression of ventilation and decreased respiratory rate.
- Patients who have received opiates need observation and/or monitoring of respiratory rate and sedation
- do not discharge home until the opiate's effects are significantly reduced
- nausea and vomiting seen in adults and children
- better controlled IV than IM—if giving IV, give small dose initially and repeat every 3-5 minutes until patient is comfortable. Individuals vary widely as to the doses needed to provide pain relief
- dangerous in situations of raised intracranial pressure without means to provide respiratory support
- in pregnant woman or girls can produce respiratory depression in the neonate

Codeine

- oral codeine, usually with paracetamol, for moderate pain
- less potent opiate than morphine and has fewer effects on the central nervous system
- Avoid in first trimester of pregnancy (facial abnormalities)
- **codeine must not be given IV as it causes profound hypotension.**
- Do not give codeine and morphine together as codeine will reduce the effect of morphine

Naloxone

Naloxone is an opiate antagonist which reverses sedative, respiratory depressive, and analgesic effects of morphine and codeine

Sedative Drugs

- may be useful with analgesics when undertaking lengthy or repeated procedures. The aim of sedation is to make the procedure more comfortable while maintaining verbal contact with the patient.
- start with small dose IV, wait 2-3 minutes, observe response and repeat if necessary
- relieve anxiety and not pain
- when given to pregnant woman or girl can result in floppy babies
- may reduce a patient's ability to communicate discomfort and therefore should NOT be given without concomitant analgesia
- side effects include hyper-excitability or prolonged sedation, delaying discharge after procedure

Midazolam

Section 4 Pain management

- is an amnesic and sedative drug
- can be given orally, intra-nasally, or IV
- has an onset time of action of 15 minutes if given orally or intra-nasally
- duration of action is about an hour after oral or intranasal use
- can cause respiratory depression
- needs monitoring of respiratory rate and depth, and pulse oximetry

Diazepam

An anxiolytic, amnesic and sedative drug also used to stop convulsions

- half the sedative potency of midazolam
- can be given orally (15 minutes to onset of action), IV or rectally (few minutes to absorption)
- can cause respiratory depression

Other agents useful for inducing Light Sedation in children

Promethazine hydrochloride (Phenergan): 0.5mg/kg Deep IM or IV, or 1 to 2 mg/kg orally – to maximum of 50mg

Chloral hydrate

single doses up to a maximum of 50mg/kg or total 1gm rectally

25-50mg/kg (max 1g), oral or rectal. 45-60 minutes before procedure

Can give 100mg/kg (max. 2g) with respiratory monitor

Can be used in conjunction with Trimeprazine at 2mg/Kg. In children over 2 years, max 60mg 1-2 hours before procedure

Post operative pain management

Provide analgesia before pain becomes established.

Use safe and effective doses of opioids along with regular paracetamol and non-steroidals to reduce the amount of opioid required.

Avoid IM injections if possible.

Give analgesia - check response - reassess

Most at risk of poor pain control are children with limited/absent verbal ability.

If pain seems out of proportion to surgical trauma consider complication and re-assessment by surgeons.

If asleep, assume pain is acceptable -don't wake up to make assessment but check regularly to ensure still asleep. If awake and lying quietly do not assume comfortable without enquiring.

Analgesia/anti-emetics during labour

- morphine 10mg IM or 2.5- 5mg IV or pethidine 50- 100 mg IM or 25-50mg IV
- promethazine 25-50 mg IM or IV, max 100mg if vomiting occurs-although some antiemetics better if given before vomiting starts

Barbiturates and sedatives should not be used to relieve anxiety in labour.

Special issues regarding pain in the newborn infant

Neonates (premature and full term) react to, and certainly feel, pain.

Infants can easily be forced to put up with suffering.

Small doses should be measured and given with an oral syringe.

Local anaesthetics must be used when they would be used in an older child undergoing the same procedure.

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Pain control during procedures in neonates

Breast feeding during procedures may be helpful.

In all cases comfort and containment (swaddling) should be provided by a parent or a nurse.

Table 5 - analgesic drug doses

Analgesic		
Morphine IV	Pain Severity	Moderate - severe
	Dose No standard dose of IV morphine Give repeated small doses until pain is relieved	Pregnant woman or girl:- 10mg diluted to 10mls – give 2mg (2mls) every 5 mins until pain relieved Over 1 year: -200 micrograms/kg – diluted to 10mls – give 2mls every 5 mins until comfortable 1-12 months 100-200 micrograms/kg – diluted to 10mls – give 1-2mls every 5 mins until comfortable Neonate - 50-100 micrograms/kg - diluted to 1ml in 1ml syringe – give 0.2mls boluses every 5 mins with dextrose 10% flush between each bolus
	Frequency of dose	4-6hrly
	Common side effects	Respiratory depression, hypotension
	Comments	Monitor - respiration - SaO ₂ - ECG (ideally)

Analgesic		
Pethidine IV or IM	Pain Severity	Moderate - severe
	Dose	Pregnant woman or girl:-1mg/Kg (maximum dose 100mg) – if given IV – dilute to 10mls and give 2 mls every 5 mins until pain relieved Obstetric/acute pain-50-100mg IM, max 400mg/24hrs, then 1-3 hrly Acute pain IV 25-50mg, repeat after 4 hours
	Frequency of dose	3 hourly
	Common side effects	Respiratory depression, hypotension
	Comments	Monitor - respiration - SaO ₂ - ECG (ideally)

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Analgesic		
Morphine oral	Pain Severity	Moderate
	Dose	Pregnant woman or girl:- 10-20mg Child over 1 year: - 400 micrograms/kg Under 1 year: - 200 micrograms/kg
	Frequency of dose	4 hourly
	Common side effects	Constipation
	Comments	Observe respiration

Analgesic		
Codeine ORAL/IM	Pain Severity	Mild -moderate
	Dose	Pregnant woman or girl :- 30-60mg Child: 0.5-1mg/kg oral or IM, same dose for neonates
	Frequency of doses	4 hours, max 240mg/24hrs for pregnant woman or girls, max 3mg/kg/24hrs for children
	Common side effects	Constipation
	Comments	Care if < 1 year DO NOT GIVE IV

Analgesic		
Paracetamol oral	Pain Severity	Mild
	Dose	Pregnant woman or girl:- 500 mg to 1 gram 6 hourly Child over 3 months: - 20mg/kg orally or rectally Under 3 months 15mg/kg PO/PR 4-6 hourly max 60mg/kg/day
	Frequency of dose	4-6hrly, max 4g/24hrs for pregnant woman or girl, max 80 mg/kg/24hrs for children
	Common side effects	
	Comments	Avoid in liver impairment

Analgesic		
Ibuprofen oral	Pain Severity	Mild - moderate
	Dose	NOT IN PREGNANCY Child:- 5mg/kg up to 30mg/kg/day in 3-4 divided doses
	Frequency of dose	6-8 hourly
	Common side effects	Avoid in asthmatics
	Comments	Not recommended for patients <10kg

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Analgesic		
Diclofenac - Oral or rectal	Pain Severity	Moderate
	Dose	Child over 6 months:- 1mg/kg orally or rectally max 150mg/day
	Frequency of dose	8hr
	Common side effects	Avoid in asthmatics and NOT IN PREGNANCY
	Comments	Not for patients under the age of 1yr

Specific Clinical Situations

Severe Pain

- give IV morphine as described above
- a further dose can be given after 5-10 minutes if sufficient analgesia is not achieved
- monitor ABC (HR, RR, chest wall expansions, BP, SaO₂)
- have IV 0.9 Ringer-Lactate or Hartmann's replacement available (20ml/Kg in a child and 500ml to 1 litre in a pregnant woman or girl)

Head Injuries

- an analgesic dose does not necessarily cause sedation
- if the patient is conscious and in pain, the presence of a potential deteriorating head injury is NOT a contraindication to giving morphine but give maximum dose of 100 micrograms/Kg in a child or 5mg in a pregnant woman or girl.
- if the patient's conscious level does deteriorate, then assess ABC. If hypoventilation occurs, ventilate with bag-valve-mask
- if necessary, a dose of naloxone will help distinguish whether reduced conscious level is due to morphine or increasing intracranial pressure but will reverse analgesia

SECTION 5 Transport of ill patients

With pregnancy related emergencies remember there are two patients: pregnant woman or girl and baby.

Preparation and planning are essential. All transfers carry potential risks.

The patient must be in the best possible condition before transfer or transport - **no patient should be stabilised 'on the way'**.



All resuscitation, emergency treatment and stabilisation must be performed before moving the patient.

Transfers of sick patients should be carried out by health workers trained in transport.

Never assume that ambulances, if available, will have equipment.

The basic principles of transport are ongoing ABCD

- Have enough oxygen
- Have enough blankets
- Have glucose for giving IV or via gastric tube

SECTION 6: Basic Life Support

Introduction

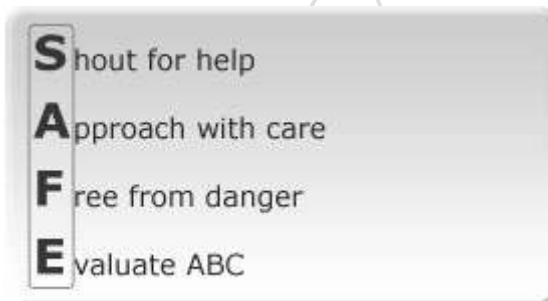
Basic Life Support is a technique that can be employed by a single rescuer to support respiratory and circulatory functions of a collapsed patient using no equipment.

Children are classified into 2 groups:

- Infants (<1 year)
- Children between 1 year and puberty

The Safe Approach

Additional help should be summoned. It is essential the rescuer does not become the second victim. Remove the patient from continuing danger.

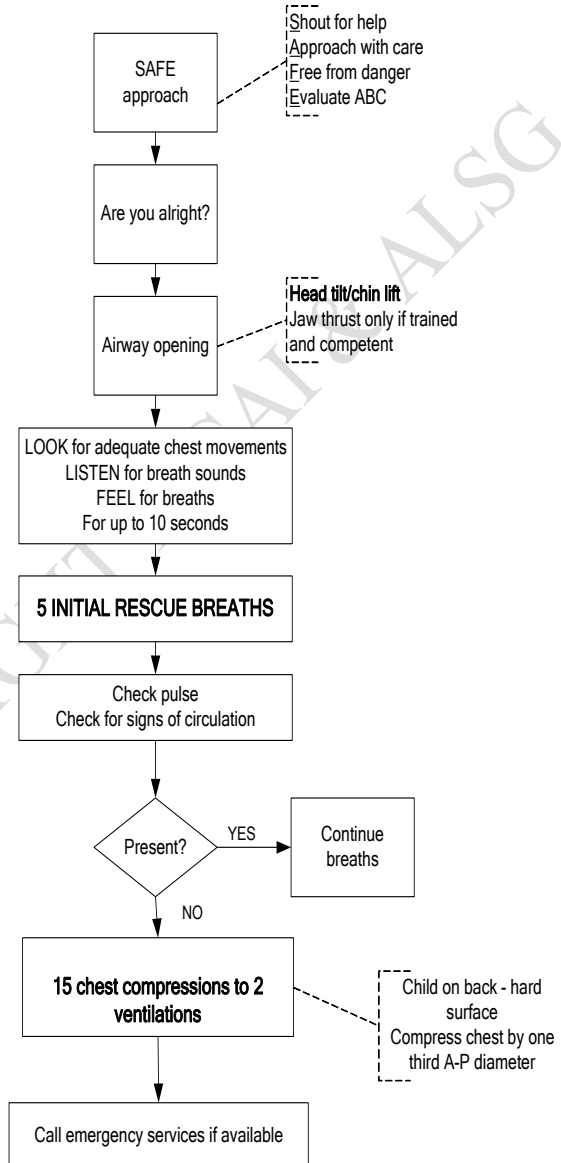


When more than one rescuer is present one starts BLS. The second person activates the Emergency Medical Services (EMS) system then returns to assist in the BLS effort.

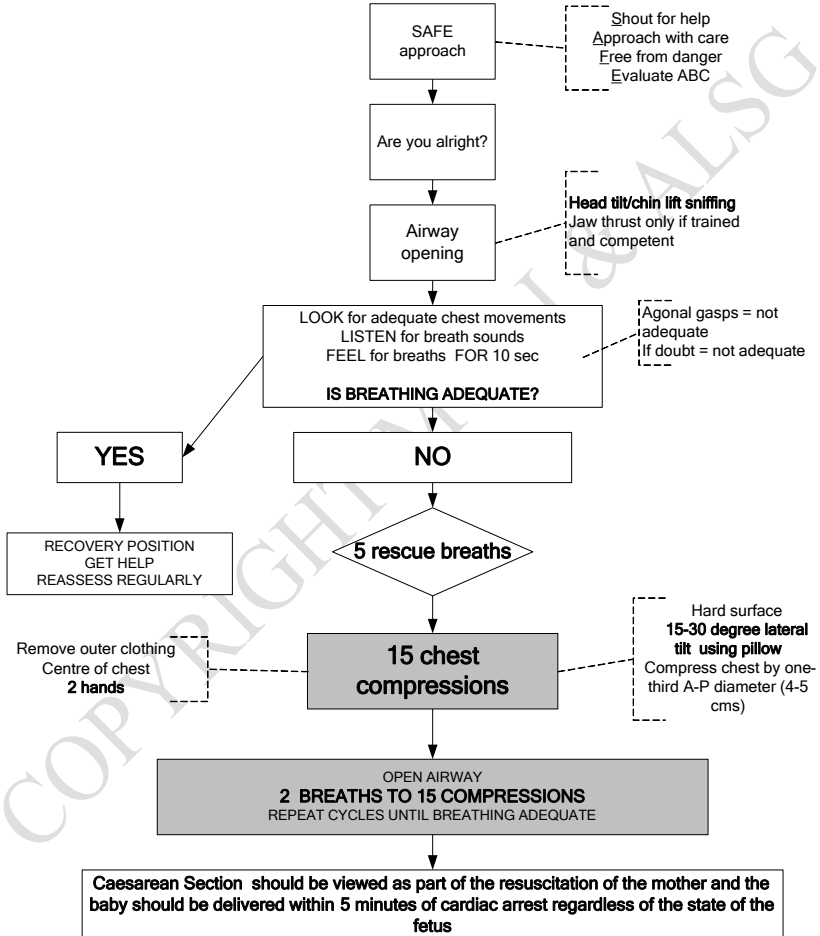
For infants and pre-pubertal children where there is only one rescuer, and no help has arrived, after 1 minute of CPR the rescuer must activate the EMS system themselves. In the case of a baby or small child the rescuer will probably be able to carry the victim to a telephone whilst continuing CPR.

In pregnancy a single rescuer should seek help as soon as there is evidence that the patient is not breathing adequately.

Pathway of Care: Basic Life Support infant and child in cardio-respiratory arrest



Pathway of Care: Basic Life Support in pregnancy



Are you alright?

An initial simple assessment of responsiveness consists of asking the patient 'Are you alright?' and gently shaking him/her by the shoulder. Infants may make some noise or open their eyes.

In cases associated with trauma, or possible trauma, the cervical spine should be immobilised during this procedure by placing one hand firmly on the forehead while one of the patient's shoulders are shaken.

Airway opening actions (A)

An obstructed airway may be the primary problem and correction of the obstruction can result in recovery without further intervention. A conscious child or pregnant woman or girl, however, will often find his/her best position to maintain an airway and should not be forced to adopt a position that makes obstruction worse or upsets the patient. If unconscious the recovery position, or if pregnant the left lateral position, must be adopted.

Diagram demonstrating recovery position



The Resuscitation Council (UK) recommends this sequence of actions to place a victim in the **recovery position**:

- Remove the victim's spectacles-if present.
- Kneel beside the victim and make sure that both her legs are straight.
- Place the arm nearest to you out at right angles to her body, elbow bent with the hand palm uppermost.
- Bring the far arm across the chest, and hold the back of the hand against the victim's cheek nearest to you.
- With your other hand, grasp the far leg just above the knee and pull it up, keeping the foot on the ground.
- Keeping her hand pressed against her cheek, pull on the far leg to roll the victim towards you onto her side.
- Adjust the upper leg so that both the hip and knee are bent at right angles.
- Tilt the head back to make sure the airway remains open.

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- *Adjust the hand under the cheek, if necessary, to keep the head tilted.*
- *Check breathing regularly.*

*If the victim has to be kept in the recovery position for **more than 30 minutes** turn to the opposite side to relieve the pressure on the lower arm.*

Airway opening actions (A)

If the patient is not breathing, it may be because the airway is blocked by the tongue falling back obstructing the pharynx. Attempt to open the airway using **head tilt/chin lift maneuver**. The rescuer placing his/her nearest hand on the patient's forehead does this, and applying pressure to tilt the head back gently. The correct positions are **neutral in the infant (0 – 1 year)** or "**sniffing**" (**nose up in the air**) in the child and pregnant woman or girl.



HEAD TILT CHIN LIFT INFANT =
NEUTRAL POSITION



HEAD TILT CHIN LIFT CHILD OR
PREGNANT PATIENT = SNIFFING
POSITION

The fingers of the other hand should then be placed under the chin and the chin should be lifted upwards. As this action may close the patient's mouth it may be necessary to use the thumb of the same hand to part the lips slightly.

If the head tilt / chin lift is not possible, or is contraindicated (possible cervical spine injury), then the **jaw thrust** maneuver can be performed.



JAW THRUST

This is achieved by placing two or three fingers under the angle of the mandible bilaterally, and lifting the jaw upward. This is the safest maneuver where there is a history of trauma as head tilt / chin lift may exacerbate cervical spine injury. Jaw thrust requires training and experience and if the rescuer is not confident then he/she should move to next step.

(A) Airway opening actions

Patency of the airway should then be assessed by :

LOOK	for adequate chest movements
LISTEN	for breath sounds
FEEL	for breaths

This is best achieved by the rescuer placing his/her face above the patient's, with the ear over the nose, the cheek over the mouth, and the eyes looking along the line of the chest. If there is anything obvious in the mouth and it is easy to reach remove it.

Do not perform a blind finger sweep of the mouth

This can damage the soft palate and foreign bodies may be forced further down the airway becoming lodged below the vocal cords.

The pregnant patient has a serious risk of regurgitation and aspiration if the airway is not opened, maintained and protected.

The causes of airway problems include:

- Head injury with decreased level of consciousness
- Other causes of decreased level of consciousness which include: hypoxaemia, hypovolaemia, cerebral malaria, meningitis, eclampsia and poisoning
- Injuries to the face and neck

Airway problems may be immediate, delayed or deteriorate with time. Careful monitoring of a patient with an airway problem, or with a condition which may deteriorate and cause an airway problem (e.g. facial burns), must be carefully managed. An airway that has been cleared may obstruct again if the patient's level of consciousness decreases, if there is further bleeding into the airway or if there is increased swelling in and around the airway. Airway obstruction must be suspected when breath sounds are absent or noisy or if the patient is cyanosed.

(B) Breathing Actions (B) in the Infant, pre-pubertal child or pregnant woman or girl

If airway opening techniques do not result in the resumption of adequate breathing within 10 seconds, and a self inflating bag/mask system is not available then exhaled air resuscitation which should be commenced.

Definition of adequate breathing A victim may be barely breathing, or taking infrequent, noisy, agonal gasps. Do not confuse this with normal breathing.

If in doubt about the adequacy of breathing, 5 initial rescue breaths should be given.

While the airway is held open, the rescuer breathes in and seals his/her mouth around the patient's mouth or mouth and nose (infant). If the mouth alone is used then the nose should be pinched using thumb and index finger of the hand maintaining head tilt. Slow exhalation, 1-2 seconds, by the rescuer should result in the patient's chest rising.



Mouth to mouth with nose pinched in sniffing airway position (child and in pregnancy)

Mouth to mouth and nose neutral position infant

Guidance for exhaled air resuscitation

- The chest should be seen to rise
- Inflation pressures may be higher because of small airways
- Slow breaths at the lowest pressure reduce gastric distension
- Firm gentle pressure on the cricoid cartilage may reduce gastric insufflation

If the chest does not rise then the airway is not clear. The usual cause is failure to apply correctly the airway opening techniques previously discussed. The first step to try is to

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readjust head tilt / chin lift position and try again. If this is not successful jaw thrust should be tried. If two rescuers are present one should maintain the airway whilst the other breathes for the patient.

Failure of both head tilt / chin lift and jaw thrust should lead to suspicion that a foreign body is causing the obstruction.

C Circulation actions in the infant, child and pregnant woman or girl

Check pulse and state of circulation (take no more than 10 seconds)

Once the initial 5 breaths have been given circulation should be assessed.

Inadequacy of circulation is indicated by the absence of a central pulse for up to 10 seconds **or in babies and young children only** by the presence of a pulse at an insufficient rate (less than 60 beats/minute) or by the absence of other signs of circulation, i.e. no breaths or cough in response to rescue breaths and no spontaneous movement. In children the carotid pulse in the neck can be palpated. Infants, however, generally have a short fat neck so the carotid pulse may be difficult to identify. The brachial artery in the medial aspect of the ante-cubital fossa or the femoral artery in the groin should be felt.

If the pulse is absent for up to 10 seconds **start compressions. Compressions should also be started** if in an infant or young child there is an inadequate heart rate (less than 60/minute) **BUT ONLY IF ACCOMPANIED BY SIGNS OF POOR PERFUSION** which include pallor, lack of responsiveness and poor muscle tone. Even experienced health professionals can find it difficult to be certain that the pulse is absent within 10 seconds so the absence of "signs of circulation" are an indication to start chest compressions also. Signs of a circulation include: movement, coughing or normal breathing (not agonal gasps - these are irregular, infrequent breaths).

Start chest compressions if:

- no pulse **OR**
- slow pulse (less than 60 per minute in infant or young child with poor perfusion) **OR**
- no signs of circulation

"Unnecessary" chest compressions are almost never damaging and it is important not to waste vital seconds before starting them. If the pulse is present – and has an adequate rate, with good perfusion – but apnoea persists, exhaled air resuscitation must be continued until spontaneous breathing resumes.

ALWAYS KEEP AIRWAY OPEN DURING CHEST COMPRESSIONS SO THAT AIR CAN BE SUCKED IN AND OUT OF THE LUNGS BY THE COMPRESSIONS (IDEALLY WITH ANOTHER PERSON HOLDING IT OPEN)

Chest compressions

For the best output the patient must be placed on his/her back, on a hard surface. The chest should be compressed by a third of its depth. Children vary in size, and the exact nature of the compressions given should reflect this. In general infants (less than 1 year)

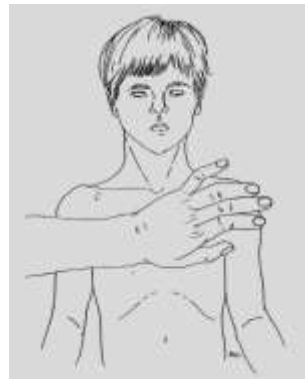
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require a technique different from children up to puberty, in whom the method used in adults can be applied with appropriate modifications for their size

Chest compressions in an infant



Chest compressions one-handed technique



Chest compressions two-handed technique



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Position for chest compressions

Chest compressions should compress the lower third of the sternum. The finger/thumb or hand position for all ages is found by finding the angle where the lowest ribs join in the middle and placing the finger/thumb or hand one finger's breadth above this.

Infants Infant chest compression can be more effectively achieved using the hand-encircling technique: the infant is held with both the rescuer's hands encircling or partially encircling the chest. The thumbs are placed over the correct part of the sternum (as detailed above) and compression carried out, as shown in Figure. This method is only possible when there are two rescuers, as the time needed to reposition the airway precludes its use by a single rescuer if the recommended rates of compression and ventilation are to be achieved. The single rescuer should use the two-finger method, employing the other hand to maintain the airway position as shown in the Figure.

Pre-pubertal children Place the heel of one hand over the lower third of the sternum one finger's breadth above the angle of the junction of the ribs. Lift the fingers to ensure that pressure is not applied over the child's ribs. Position yourself vertically above the child's chest and, with your arm straight, compress the sternum to depress it by approximately one third of the depth of the chest (Figure).

For **larger children or pregnant woman or girl**, or for small rescuers, this may be achieved most easily by using both hands with the fingers interlocked (Figure). The rescuer may choose one or two hands to achieve the desired compression of one third of the depth of the chest.

Once the correct technique has been chosen and the area for compression identified, **15 compressions should be given to 2 ventilations.**

Continuing cardiopulmonary resuscitation

The compression rate at all ages is 100 per minute. A ratio of 15 compressions to 2 ventilations is maintained whatever the number of rescuers. If no help has arrived the emergency services must be contacted after 1 minute of cardiopulmonary resuscitation. With pauses for ventilation there will be less than 100 compressions per minute although the *rate* is 100 per minute. Compressions can be recommenced at the end of inspiration and may augment exhalation. *Apart from this interruption to summon help, basic life support must not be interrupted unless the patient moves or takes a breath.*

Any time spent readjusting the airway or re-establishing the correct position for compressions will seriously decrease the number of cycles given per minute. This can be a real problem for the solo rescuer, and there is no easy solution. In the infant and small child, the free hand can maintain the head position. The correct position for compressions does not need to be re-measured after each ventilation.

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Table 6 Summary of basic life support techniques in infants and children

	Infant (<1 yr)	Child (1 yr to puberty) and pregnant woman or girl
Airway		
Head-tilt position	Neutral	Sniffing
Breathing		
Initial slow breaths	Five	Five
Circulation		
Pulse check	Brachial or femoral	Carotid
Landmark	One finger-breadth above xiphisternum	One finger-breadth above xiphisternum
Technique	Two fingers or two thumbs	One or two hands
CPR ratio	15:2	15:2

Call emergency services (if they exist)

If no help has arrived, the emergency services must be contacted after a minute of resuscitation has been delivered. An infant or small child may be carried to a telephone or to get help and attempts continued. Apart from this interruption to summon help, basic life support must not be interrupted unless the patient moves or takes a breath.

Special Circulation Actions in the pregnant woman or girl

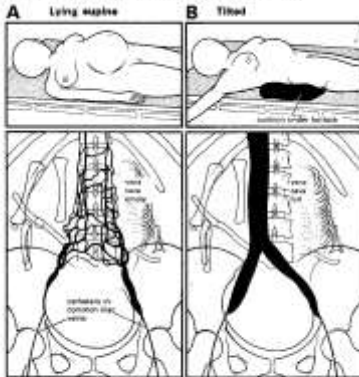
Call for emergency help (you may have to leave the victim alone).

Place on hard surface in the left lateral tilt position (use pillow or coat or whatever available).

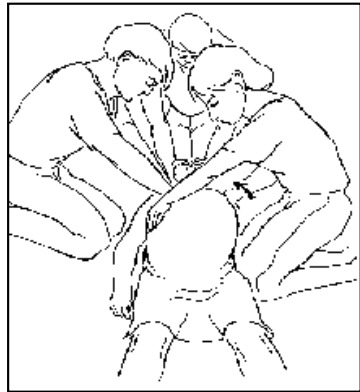
To overcome vena caval compression a wedge must be placed under the right hip to displace the gravid uterus to the left. If an assistant is available they can lift the uterus off the vena cavae. Effective chest compressions can be accomplished at a 15-30 degree tilt to the left.

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THE SUPINE HYPOTENSIVE SYNDROME



THE SUPINE HYPOTENSIVE SYNDROME. These are both xerograms. A, the mother is lying on her back, her uterus is occluding her vena cava, and all the blood from the lower part of her body is flowing through her paravertebral veins. B, a pillow has now been put under her right buttock tilting her to the left. Blood is now flowing normally in her vena cava. Kindly courtesy of Murray Grossbart.



LATERAL TILT AND /OR UTERINE DISPLACEMENT

Give 5 rescue breaths and then give 15 chest compressions. Loosen the outer clothing and using 2 interlocking hands

- Kneel by the side of the victim.
- Place the heel of one hand in the centre of the victim's chest.
- Place the heel of your other hand on top of the first hand.
- Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs. Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone).
- Position yourself vertically above the victim's chest and, with your arms straight, press down on the sternum 4 - 5 cm.
- After each compression, release all the pressure on the chest without losing contact between your hands and the sternum.
- Repeat at a rate of about 100 times a minute (a little less than 2 compressions a second).
- Compression and release should take an equal amount of time.



Combine chest compression with rescue breaths.



- After 15 compressions open the airway again using head tilt and chin lift (use jaw thrust if you are experienced and capable of doing it properly)
- Pinch the soft part of the victim's nose closed, using the index finger and thumb of your hand on her forehead.
- Allow her mouth to open, but maintain chin lift.
- Take a normal breath and place your lips around her mouth, making sure that you have a good seal.
- Blow steadily into her mouth whilst watching for her chest to rise; take about one second to make her chest rise as in normal breathing; this is an effective rescue breath.
- Maintaining head tilt and chin lift, take your mouth away from the victim and watch for her chest to fall as air comes out.
- Take another normal breath and blow into the victim's mouth once more to give a total of two effective rescue breaths. Then return your hands without delay to the correct position on the sternum and give a further 15 chest compressions.
- Continue with chest compressions and rescue breaths in a ratio of 15:2.
- Stop to recheck the victim only if she starts breathing **normally**; otherwise **do not interrupt resuscitation**.
- If your rescue breaths do not make the chest rise as in normal breathing, then before your next attempt:
 - Check the victim's mouth and remove any visible obstruction.
 - Recheck that there is adequate head tilt and chin lift.
 - Try jaw thrust if you are able to do this effectively
- Do not attempt more than two breaths each time before returning to chest compressions.
- ***If there is more than one rescuer present, another should take over CPR about every 2 min to prevent fatigue. Ensure the minimum of delay during the changeover of rescuers.***

Chest-compression-only CPR.

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- If you are not able, or are unwilling, to give rescue breaths, give chest compressions only.
- If chest compressions only are given, these should be continuous at a rate of 100 a minute.

Stop to recheck the victim only if she starts breathing **normally**; otherwise do not interrupt resuscitation.

Continue resuscitation until:

- qualified help arrives and takes over
- the victim starts breathing normally
- you become exhausted.

Section 7 CHOKING IN THE CHILD

Introduction

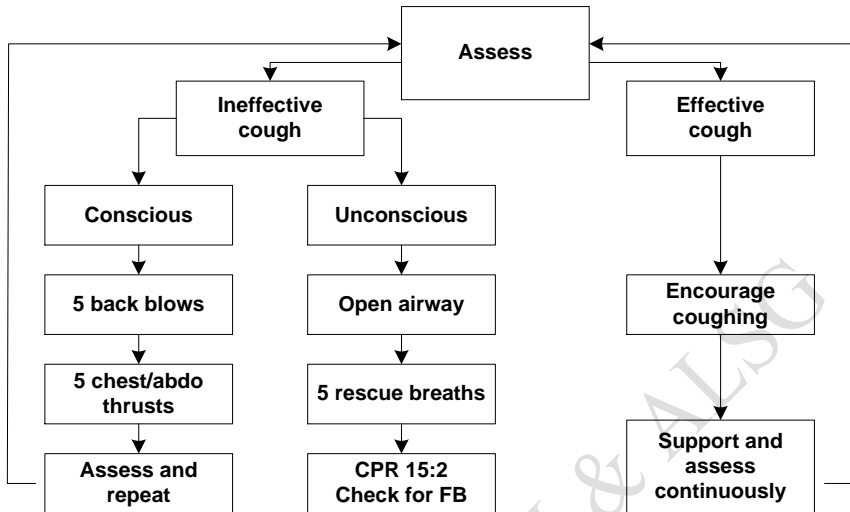
Suspect if sudden respiratory compromise with coughing, gagging and stridor.

Airway obstruction also occurs with infections such as acute epiglottitis and croup. In these cases attempts to relieve the obstruction using the methods described below are dangerous. Children with known or suspected infectious causes of obstruction, and those who are still breathing and in whom the cause of obstruction is unclear should be taken to hospital urgently.

If a foreign body is easily visible and accessible in the mouth then remove it but while attempting this, take great care not to push it further into the airway. Do not perform blind finger sweeps of the mouth or upper airway as these may further impact a foreign body and damage tissues without removing the object.

The physical methods of clearing the airway, described below, should therefore only be performed if:

1. The diagnosis of foreign body airway obstruction is clear-cut (witnessed or strongly suspected) and ineffective coughing and increasing dyspnoea, loss of consciousness or apnoea have occurred.
2. Head tilt/chin lift and jaw thrust have failed to open the airway of an apnoeic child.



If the child is coughing she/he should be encouraged. A spontaneous cough is more effective at relieving an obstruction than any externally imposed maneuver. An effective cough is recognised by the victim's ability to speak or cry and to take a breath between coughs. The child should be continually assessed and not left alone at this stage. No intervention should be made unless the cough becomes ineffective, that is quieter or silent, and the victim cannot cry, speak or take a breath, or if he becomes cyanosed or starts to lose consciousness. Then call for help and start the intervention.

These manoeuvres are then alternated with each other, and with examination of the mouth and attempted breaths as shown in the above figure.

Infants

Abdominal thrusts may cause intra-abdominal injury in infants. Therefore a combination of back blows and chest thrusts is recommended for the relief of foreign body obstruction in this age group.

The baby is placed along one of the rescuer's arms in a head-down position, with the rescuers hand supporting the infant's jaw in such a way as to keep it open, in the neutral position. The rescuer then rests his or her arm along the thigh, and delivers 5 back blows with the heel of the free hand.

If the obstruction is not relieved the baby is turned over and lay along the rescuer's thigh, still in a head-down position. Five chest thrusts are given using the same landmarks as for cardiac compression but at a rate of one per second. If an infant is too large to allow use of the single-arm technique described above, then the same manoeuvres can be performed by laying the baby across the rescuer's lap.

Section 7 Choking



Figure Back blows in infant



Figure Chest thrusts in an infant

Children

Back blows can be used as in infants or in the case of a larger child, with child supported in a forward leaning position. In the child the abdominal thrust (Heimlich manoeuvre) can also be used. This can be performed with the victim either standing or lying but the former is usually more appropriate.

If this is to be attempted with the child standing, the rescuer moves behind the victim and passes his or her arms around the victim's body. Owing to the short height of children, it may be necessary for an adult to raise the child or kneel behind them to carry out the standing manoeuvre effectively. One hand is formed into a fist and placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed over the fist, and both hands are thrust sharply upwards into the abdomen. This is repeated 5 times unless the object causing the obstruction is expelled before then.

To carry out the Heimlich maneuver in a supine child, the rescuer kneels at his or her feet. If the child is large it may be necessary to kneel astride him or her. The heel of one hand is placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed on top of the first, and both hands are thrust sharply upwards into the abdomen, with care being taken to direct the thrust in the midline. This is repeated 5 times unless the object causing the obstruction is expelled before that.



Section 7 Choking

Figure Back blows in a small child

Following successful relief of the obstructed airway assess the child clinically. There may be still some part of the foreign material in the respiratory tract. If abdominal thrusts have been performed the child should be assessed for possible abdominal injuries.

Each time breaths are attempted look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues. If the obstruction is relieved the victim may still require either continued ventilations if not breathing, and chest compressions if there are no signs of a circulation.



Figure Heimlich maneuver in a standing child

Section 7 Choking

If the child breathes effectively then place him in the recovery position and continue to monitor him.

Unconscious infant or child with foreign body airway obstruction

- Call for help.
- Place the child supine on a flat surface.
- Open the mouth and attempt to remove any visible object.
- Open the airway and attempt 5 rescue breaths, repositioning the airway with each breath if the chest does not rise.
- Start chest compressions even if the rescue breaths were ineffective.
- Continue the sequence for single rescuer CPR for about a minute then summon help again if none is forthcoming.
- Each time breaths are attempted, look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues.
- If the obstruction is relieved the victim may still require either continued ventilations if not breathing but is moving or gagging or both ventilations and chest compressions if there are no signs of a circulation. Advanced life support may also be needed.
- If the child breathes effectively then place her/him in the recovery position and continue to reassess.

SECTION 8 Advanced Life Support

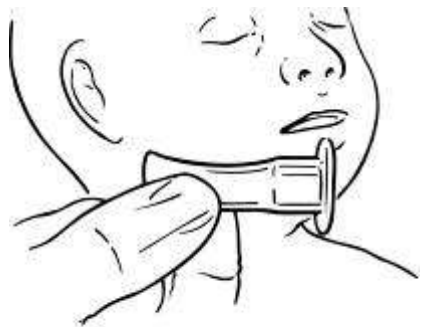
AIRWAY: Equipment and skills for opening and maintaining the airway

Suction

Remove blood and secretions from the mouth with a rigid suction tube. If attempts to clear the airway do not result in spontaneous breathing, this may be because the airway is still not patent or because the airway is open but there is no breathing.

To clear the oropharynx of debris eg.vomit a rigid sucker (e.g. Yankauer) should be used with care not to damage delicate tissue or induce vomiting.

Oro-pharyngeal airway



Correct Size

The **oro-pharyngeal or Guedel airway** is used in the unconscious or obtunded patient to provide an open airway channel between the tongue and the posterior pharyngeal wall. In the awake patient or lightly unconscious patient with an intact gag reflex, it may not be tolerated and may induce vomiting, laryngospasm or apnoea and is therefore potentially dangerous.

A correctly sized oro-pharyngeal airway when placed with its flange at the centre of the incisor teeth, then curved around the face, will reach the angle of the mandible. Too small an airway may be ineffective; too large an airway may cause laryngospasm. Either may cause mucosal trauma or may worsen airway obstruction. Reassessment following placement is therefore a vital part of safe insertion of an airway device.

There are two methods for inserting the oro-pharyngeal airway depending on whether the child is small or large – however there is no especial age for change – it depends on practicality and skills of operator. The important issue is not to push the tongue back by inserting carelessly.

Section 8 Advanced life support-oro-pharyngeal airway

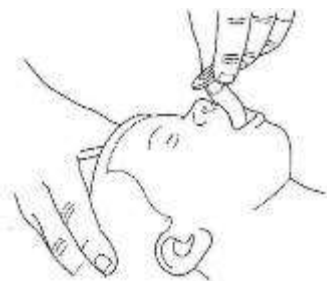
The twist technique is used for the larger child and adult and means that the convex side of the airway is used to depress the tongue as the airway is pushed into the mouth.

However, in the infant and small child, as the tongue is bigger relative to the size of the mouth, you can't turn it over after it's in the back of the mouth without causing trauma; hence the tongue is controlled with a spatula and not by the reversed airway. With small undernourished children up to (say) 5 years and babies use the spatula to depress the tongue and place the airway without rotation.

The test of success, as in all therapeutic interventions, is that insertion of one of these devices should result in improvement in the patient's condition. If it does not occur then a reappraisal of the choice or size of airway is urgently required.



Inserting airway in an infant and small child



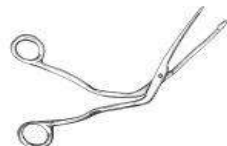
concave side up



turning it around

Magill's forceps

Used to grasp a foreign body in the throat and remove it.

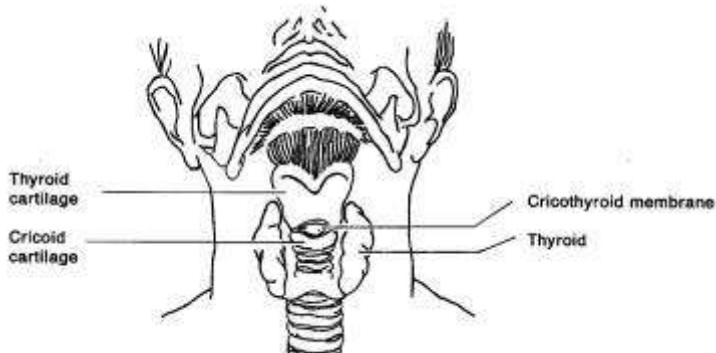


Emergency Surgical airway: Surgical cricothyroidotomy

Only in desperate situation if other methods of airway opening procedures have failed

Call surgeon (ENT) and anaesthetist (if available)

1. Place supine.
2. If no risk of neck injury, consider extending neck to improve access. Otherwise, maintain a neutral alignment.
3. Identify cricothyroid membrane in the following manner. Place your finger over the most prominent part of thyroid cartilage (Adam's apple). Move the finger downwards i.e. towards the chest, keeping strictly in the mid-line. The first dip felt is the area of cricothyroid membrane.
4. Prepare skin and, if patient is conscious, infiltrate with local anaesthetic.



5. Place index and middle fingers of your left hand on each sides of midline of neck to stabilise cricothyroid membrane, and to protect lateral vascular structures from injury.
6. Make a small vertical incision in skin, and with the index and the middle fingers of the left hand, press lateral edges of incision outwards, to minimise bleeding.
7. Make a transverse incision through cricothyroid membrane, being careful not to damage cricoid cartilage.
8. Insert a tracheal spreader to open airway.
9. Insert an appropriately sized endotracheal or tracheostomy tube. It is advisable to use a slightly smaller size than would have been used for oral intubation e.g. size 6.0mm internal diameter for age 12-16years or size 7.0mm for adults.
10. Ventilate patient and check that this is effective – if not and if large air leak after inflating cuff may need to change tube for a size bigger.
11. Secure tube to prevent dislodgement.

Complications

- Asphyxia: Aspiration of blood or secretions: Haemorrhage or haematoma.
- Creation of a false passage into tissues: Surgical emphysema (subcutaneous or mediastinal).
- Pulmonary barotraumas: Subglottic oedema or stenosis: oesophageal perforation.
- Infection.

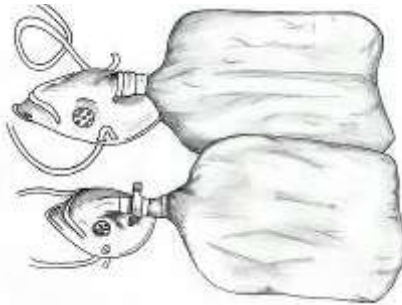
BREATHING: Equipment and skills for helping the patient to breathe

Oxygen

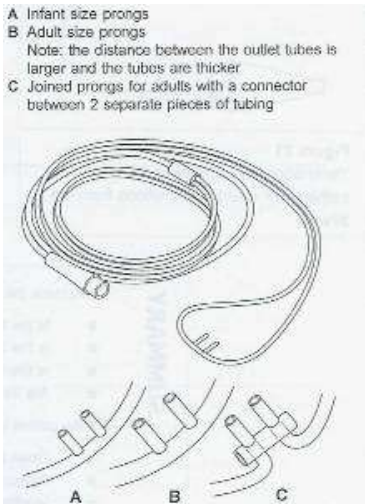
Give oxygen if respiratory distress (recessions, nasal flaring, head bobbing etc.) or if cyanosis (blueness) is central (around lips and tongue or inside mouth (difficult to see in black children) or if shocked or if fitting. If SaO₂ monitoring is available give O₂ if SaO₂ < 92% consistently (unless at high altitude)

If oxygen supplies are limited, use oxygen at sufficient flow rates to maintain oxygen saturations at >94%. If using low flow rates do not use reservoir bag

If using oxygen mask, ensure that mask is large enough to cover mouth and nose. Both low and high flow O₂ (up to 15l/min) can be given. Hold mask in place using the elastic strap around back of head or ask mother to hold it as close as possible to child's face.



A mask with a reservoir bag allows up to 100% oxygen to be delivered. Without a reservoir, it is only possible to deliver around 40%.



Nasal cannulae come in 3 sizes small, medium, large to give O₂ concentrations of up to 40%. Nasal cannulae have a curved appearance; apply by placing curve of cannulae into natural curve of nasal passage. Secure with small



Section 8 Advanced life support-oxygen
piece of tape on both cheeks over tubing.

O₂ cylinders contain compressed gas. A flow meter needs to be fitted to regulate flow. A hissing noise can be heard if gas is being delivered.

Take the reading of flow rate from the middle of the ball. Always switch off flow when not in use; ensure indicator ball at bottom of flow meter and not moving.

DO NOT leave anything flammable near to the O₂ supply. DO NOT ALLOW SMOKING near to O₂.

Check adequate O₂ supply is available at least 3 times a day (use a signed log book). If gauge indicating amount left in cylinder is not available, switch on flow and listen to hiss. Replace empty cylinders as they empty. Ensure cylinders are stored in an upright position on a flat surface and are secure. Cylinder keys should be tied to each cylinder.

Oxygen concentrators may be available. They give >95% oxygen with a flow of 1-8 L/min.

Face masks with seal over nose and mouth for positive pressure ventilation

These are used for either mouth to mask or more commonly bag-mask ventilation. Masks are available in various sizes and the appropriate size to cover the mouth and nose should be chosen.



Self-inflating bags

This is one of the most important pieces of equipment allowing hand ventilation by facemask without a supply of gas. The two appropriate sizes are **500ml** and **1600ml (the smaller for infants <1 year and the larger for children and pregnant woman or girl)**. These bags have pressure-limiting valves that operate at between 30 and 45cm H₂O. **Test the valve** by placing the mask on a surface and pressing the bag and ensuring the valve opens. It can be overridden if necessary for stiff, poorly compliant lungs.

Section 8 Advanced life support-bag valve mask inflations

The bag connects to the patient through a one-way valve to direct exhaled gas to the atmosphere. The other end connects to the oxygen supply and can attach to a reservoir bag which allows high concentrations of oxygen to be delivered (can be up to 98%). Without the reservoir bag concentrations of up to 40% O₂ are delivered. The bag itself is easily dismantled and reassembled. It is important to realize that this system **will operate** without an attached oxygen supply, allowing resuscitation to be initiated before oxygen is available. However, if resuscitation is failing, check that oxygen is being delivered into the bag and patient and that O₂ has not been disconnected.

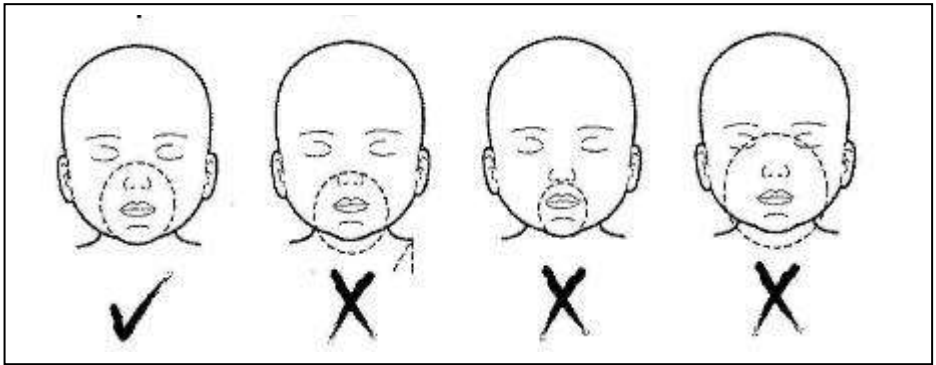
Always use high flow oxygen and reservoir bag during resuscitation

Clean the system after each patient

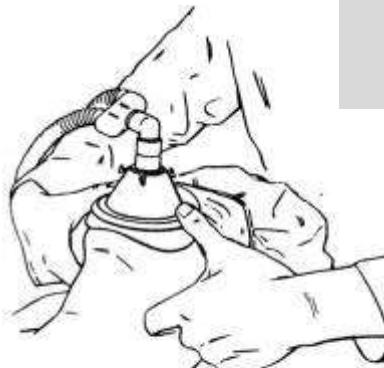
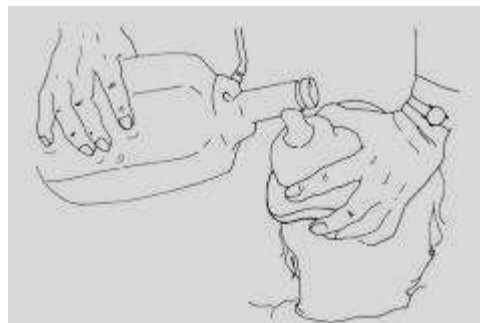


It is essential that the mask is properly sized and correctly placed over the mouth and nose of the patient.

Section 8 Advanced life support-bag valve mask inflations



Mask holding techniques



Section 8 Advanced life support-bag valve mask inflations

If the chest does not rise then the airway is not clear. The usual cause is failure to apply correctly the airway opening techniques previously discussed. The first step to try is to readjust head tilt / chin lift position and try again. If this is not successful jaw thrust should be tried. Failure of both head tilt / chin lift and jaw thrust should lead to suspicion that a foreign body is causing the obstruction.

Once breathing restarts, replace bag-valve-mask system with simple face-mask and reservoir. Because of the internal valves it is not possible to spontaneously breathe through the bag-valve-mask system.

Pulse Oximetry

1. Switch on the oximeter.
2. Make sure any mains supply is also switched on (this will charge the internal battery, if this exists) - the sensor should light up.
3. Apply the sensor to a relatively translucent part of the body, for example, a finger or toe in a child or adult, or to the side of the foot, the palm, thumb or big toe in an infant.
4. Fix the sensor in position:
 - flexible sensors should be secured with either their own sticky tape, or additional sticky tape that stretches, so arterial pulsations are not impaired
 - rigid sensors, or 'crocodile clips,' usually attach on a finger and do not need further fixation
5. In situations of bright light, or poor skin perfusion, consider covering the sensor further using, for example, a glove, mitten, or sock.
6. Wait for a short period of time, usually 30 seconds, before reading the measurement of SaO₂ and heart rate from the oximeter, but only when an adequate arterial (or other) pulsation is found. Most oximeters will have either a bouncing bar display or arterial pulse waveform that is in time with the patients pulse or heart rate.
7. Set the low and high alarm limits for the oxygen saturation (eg 85% and 100%) and pulse rate.
8. Take readings of SaO₂ and pulse rate when a good pulsation is present and the values are relatively stable.

Normal Values

- These are usually 95-100% when breathing room air at sea level, and in the presence of good pulse detection. AIM TO KEEP SAO₂ 94-98%.
- Lower levels if breathing or cardiac problems.
- Low levels whilst breathing additional oxygen usually indicate very serious breathing problems.
- Normal levels whilst breathing additional oxygen do not mean that ventilation is normal (may have a significant retention of carbon dioxide).
- May not get accurate reading if patient shivering, moving, if cold hands or feet, wearing nail varnish or if there is carbon monoxide poisoning, as with for example burns.
Note: skin colour, sickle cell disease and other haemoglobin disorders do not significantly affect the measurement of SaO₂.

Spacers and nebulisers

Spacers

- Salbutamol can be delivered using spacer device 2-10 puffs ½-4 hourly.

Section 8 Advanced life support-nebuliser and spacers

- 0-3 years use mask and spacer. Take MDI and shake, place in end of spacer, ensure good facial seal (distraction and play are useful to ensure compliance). Press MDI once and ask child to take 5 normal (effective) breaths, press MDI second time and repeat (NB if breaths ineffective request 10 instead of 5 breaths). Shake MDI after each 2 puffs, as if this is not done only propellant will be delivered.
- Assess benefit after 10 puffs (whole process takes 5-10 minutes dependant on compliance).
- This can be repeated every ½ hour. As symptoms improve increase time between treatments to 1 hourly/2 hourly/4 hourly. Usually need to have 10 puffs 4 hourly for 48 hour then 2 puffs as required.
- After 3 years of age the mouth piece of the spacer can be used.
- If patient is requiring O₂ therapy via nasal cannula < 2 litres/minute it can be continued whilst spacer treatment is delivered.

Use of a spacer

- When spacer is new, and also between treatments, it should be washed with warm soapy water and left to dry naturally. Drying by any other means will build up static and encourage the drug to stick on the sides of the spacer rather than be delivered to the patient.
- As child takes a breath with a commercial spacer, a disk will be seen and heard to move back and forth allowing medication to be delivered. If child sleeping and still requiring treatment then the spacer and mask can be used. Place the mask over mouth and nose ensuring good seal. Tilt spacer 40° angle to open valve, medication will be naturally delivered. Ensure 5-10 breaths between puffs.

If there is no proper spacer:

- *A very effective spacer can be made using a plastic IV fluid bottle – see picture or soft drink bottle.*
- *Failing this an effective aid to inhalation is a paper bag. Express salbutamol into the paper bag and place the bag tightly around the nose and mouth of the patient. Have the patient breathe in and out ten times.*



Section 8 Advanced life support-nebuliser and spacers

Nebuliser

- Nebulisers can be driven by oxygen or electrically (must deliver at least 6-9 litres/minute). If severe asthma and possible hypoxia, use O₂ to drive the nebuliser.
- Need regular cleaning and servicing.
- Equipment required
 - Straight O₂ tubing (bubble tubing can be used if this is all that is available)
 - Medication chamber
 - Mask

Attach tubing to medication chamber, add dose of salbutamol to medication chamber and attach mask.

Switch O₂ on at 8 litres/minute (= best flow for dispersment of medication).

Continuous nebulised treatment can be given until symptoms improve. Then treatments can be reduced 1 hourly/2hourly/4 hourly and then as required to control symptoms.

Change to MDI and spacer prior to discharge.

Mask should always be used for <7 years.

>7 year mouthpiece can be attached instead of mask. However this is difficult to use in severe asthma.

- Between treatments medication chamber and mask should be washed with warm soapy water and left to dry naturally.

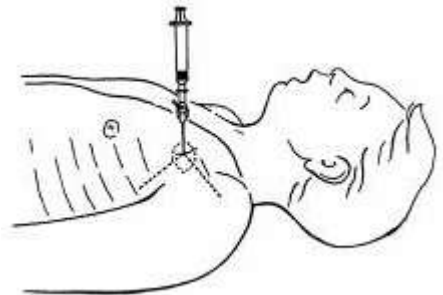
***If there is no nebuliser:
Use a spacer and give salbutamol continuously***

Needle thoracocentesis

When a tension pneumothorax is present this procedure can be life saving. It can be performed quickly with minimum equipment. A confirmatory CXRay is not required or appropriate. It should be followed by chest drain placement.

Procedure for thoracocentesis

- Identify second intercostal space in mid-clavicular line on the side of the pneumothorax (opposite side to the direction of tracheal deviation)
- Swab chest wall with surgical prep
- Attach syringe ideally via a 3 way tap to needle / IV cannula/butterfly
- Insert needle / cannula vertically into chest wall, just above the rib below to avoid vessels, and aspirate
- If air is aspirated, leave cannula in place and proceed to chest drain insertion



Section 8 Advanced life support-chest drain

Chest drain insertion This is best performed by an open technique as this minimizes lung damage by avoiding use of the trochar. The largest tube which will pass between the ribs is used.

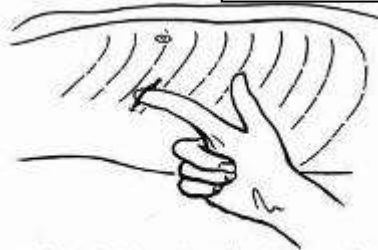
Indications

- Post thoracocentesis
- Simple pneumothorax
- Haemo-pneumothorax



Procedure

- Prepare patient – this must be a fully sterile procedure
- Identify landmarks – 4th or 5th intercostal space, mid-axillary line (4th intercostal space in pregnancy)
- If conscious use local anaesthetic
- Make a 1-3 cm incision immediately above the rib below (to avoid damage to the neurovascular bundle under the lower edge of the rib)
- Use artery forceps for blunt dissection between the ribs and puncture the pleura
- If possible, clear the path with a gloved finger (not possible in babies / small children)
- Hold about 1 cm from end and pass the chest drain through the hole and ensure all side holes are within the chest
- Connect to underwater seal or Heimlich valve
- Check the tube is in place (misting should occur and air entry should improve)
- Suture tube in place - make sure the area is anaesthetised
- Cover wound and get CXR if possible
- Check the patient has improved
- Ensure water level is always below the chest to prevent water leaking back into the chest
- Suture tube in place - make sure the area is anaesthetized. Leave an additional suture untied adjacent to the tube for closing the wound after the tube is removed



Chest drain insertion - clearing the path

*If there is no Heimlich valve?
One can be made using the finger of a sterile surgical glove.*

Section 8 Advanced life support-chest drain

Complications of chest drains

1. Failure to position properly
2. Infection
3. Surgical (subcutaneous) emphysema
4. Haemorrhage
5. Damage to internal thoracic artery if drain is placed too medially
6. Damage to intrathoracic or abdominal structures
7. Kinking of chest tube or obstruction by blood clot

CIRCULATION: Equipment and skills for maintaining the circulation

Intraosseous cannulation and infusion



Indication

In emergency when other attempts at IV access have failed in an infant, child or pregnant woman or girl

1. Identify the infusion site. The landmark for the upper tibial site is the anterior surface, 2 - 3 cm below the tibial tuberosity
2. Clean the skin over the chosen site and apply sterile drapes.
3. Insert local anaesthetic (1% lidocaine with fine needle 22-25G) down to periosteum if patient is conscious.
4. Insert the needle at 90° to the skin. Ideally 18G intra-osseous needle (at least 1.5cm in length). In situation of poor resources, a lumbar puncture needle or even standard 16-18 gauge needle can be used. For infants 21G green needles are quite adequate. A butterfly needle which has a short bevel may also be helpful in the infant.
5. Continued to advance the needle in a rotating fashion until a give is felt as the medullary cavity of the bone is entered. The needle should stand up by itself.
6. Attach the 5 ml syringe and aspirate blood/marrow for as required; cross match, Hb, culture, glucose and then flush with 0.9% saline or Ringer-Lactate or Hartmann's to expel clots and observe for subcutaneous swelling to confirm correct positioning.

Section 8 Advanced life support-intraosseous cannula

7. Attach the 50 ml syringe, usually containing, Ringer-Lactate or Hartmann's, but can be compatible blood or 10% glucose if hypoglycaemia is suspected, and push in the infusion fluid in boluses.
8. Secure IV access as soon as possible. When needle is removed cover with sterile dressing.
9. Do not place distal to a major fracture or where there is infection.
10. GIVE PROPHYLACTIC ANTIBIOTICS after immediate emergency is managed.

Complications

Dislodgement

Misplacement (penetration through posterior cortex, failure to penetrate cortex producing

- haematoma
 - tissue necrosis
 - compartment syndrome
- Skin infection
Osteomyelitis
Tibial fracture in babies

Useful issues

All drugs and fluids used for treating a sick child can be given.

IV access should be obtained as soon as possible after IO placement so that IO needle can be removed to reduce complication risk.

Measurement of Hb, platelets and wbc counts are inaccurate, but blood group and cross match and blood cultures can be performed.

External jugular vein

- Place in a 15 to 30° head-down position (or with padding under shoulders so that head hangs lower than shoulders).
- Turn head away from site of puncture. Restrain child as necessary in this position.
- Clean skin.
- Identify external jugular vein, which can be seen passing over sternocleidomastoid muscle at junction of its middle and lower thirds.
- Have an assistant place his or her finger at lower end of visible part of vein just above clavicle. This stabilises it and compresses it so that it remains distended.
- Puncture skin and enter vein.
- When free flow of blood is obtained, ensure no air bubbles are present in tubing and then attach a giving set.
- Tape cannula securely.

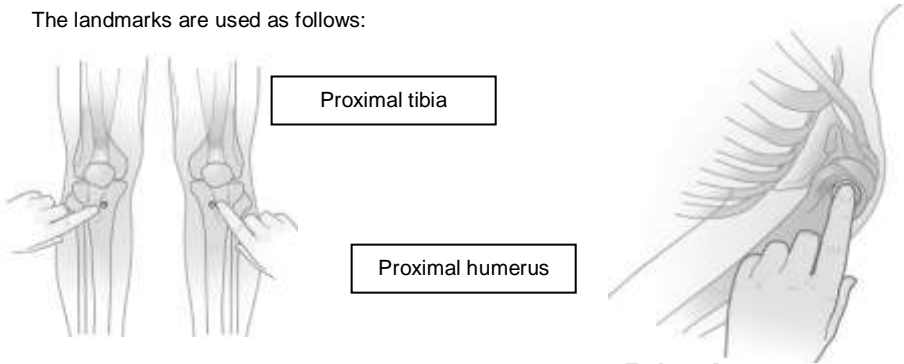
INTRAOSSUEOUS INFUSION – USING POWERED DEVICES IN PREGNANCY

The EZ-IO drill is a powered device which enables rapid insertion of an intraosseous needle.



Section 8 Advanced life support-intraosseous cannula

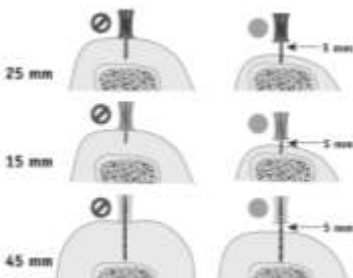
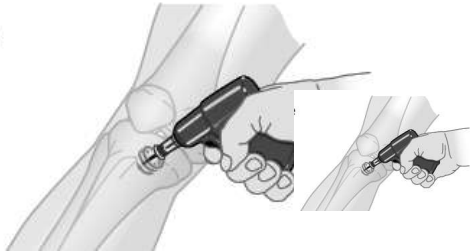
The landmarks are used as follows:



The procedure is less painful for the conscious victim due to its rapidity and the sharpness of the needles. The EZ-IO needles are in two sizes - under 40kg and over 40kg.

The procedure for insertion is as follows:

1. Universal precautions for sterile procedure
2. Clean site.
3. Choose appropriate size needle and attach to drill - it will fix magnetically
4. Remove the safety cap from the needle
5. If conscious control patient's movement during insertion
6. Hold the drill and needle at 90 degrees to the skin surface and push through the skin without drilling, until bone is felt. Ensure at least 5mm of the needle is visible at this point.



7. Squeeze the drill button and drill continuously and apply gentle, steady downward pressure until there is sudden loss of resistance - there is a palpable give as the needle breaches the cortex. Release trigger and stop insertion at this point.

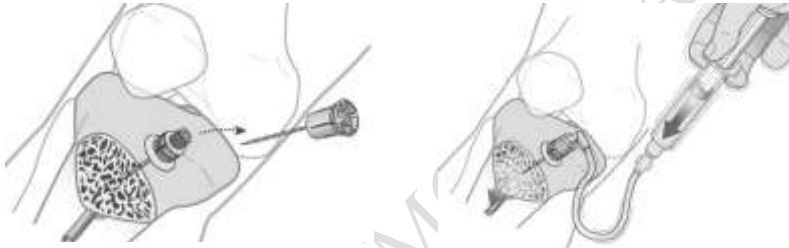
NOTES: If the driver stalls and will not penetrate the bone you may be applying too much downward pressure.

If the driver fails (rare) remove it, grasp the needle kit by hand and twist it into the bone marrow.

8. Remove drill and unscrew trochar.

9. Aspirate marrow if possible directly from needle.

10. Attach pre-prepared connection tube containing sterile Ringer-Lactate or Hartmann's before any infusion is given



Do not attach a syringe directly to the EZIO catheter hub except when drawing blood with the needle set stabilised by hand (sterile).

11. There is an optional device to secure the needle but this is not essential.

12. Proceed with required therapy.

It should be noted that rapid infusion of fluid may be painful for the conscious patient and if this proves to be the case 0.5ml/kg of 2% lignocaine may be infused slowly to combat this.

13. Apply sterile dressing

14. When removing the catheter, attach luer lock syringe, continuously rotate clockwise whilst slowly and gently applying traction to the catheter. Do not rock or bend the catheter during removal.



15. DO NOT LEAVE THE IO CATHETER IN PLACE FOR MORE THAN 24 HOURS.

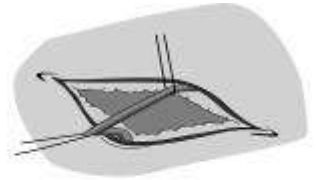
Cut down long saphenous venous cannulation

Indication: continuous IV access where percutaneous attempts have failed: (in an emergency an infant or child intra-osseous access is faster and easier)

Equipment

Procedure

Make a transverse incision two finger breadths superior and two fingers anterior to the medial malleolus. Use the *patient's* finger breadths to define the incision; this is particularly important in the infant or child. Identify landmarks:



Infant

Half a fingerbreadth superior and anterior to medial malleolus

Small child

one fingerbreadth superior and anterior to medial malleolus

Older child and

pregnant woman or girl

two fingerbreadths superior and anterior to medial malleolus

1. Immobilise limb and apply blood pressure cuff at pressure between venous and arterial
2. Clean skin and drape with sterile towels.
3. Infiltrate local anaesthetic into skin after marking the site of the vein (if conscious).
4. Incise skin perpendicular to long axis of vein.
5. Bluntly dissect subcutaneous tissues with curved artery forceps (tips pointing downwards) parallel to vein. With tips pointing up scoop up tissues and open the forceps- you should have picked up vein. Clear about 2cm of vein from surrounding tissue.
6. Insert the largest possible venous cannula into it as you would if going through the skin and then remove the trochar.
7. Close incision with interrupted sutures, place antiseptic ointment (eg iodine) over wound, and suture catheter to skin (ensure local anaesthetic at suture site if conscious).

Nasogastric tubes

Insertion of a gastric tube is essential after intubation and may also relieve respiratory distress in spontaneously breathing patients with abdominal emergencies or gastric stasis. It allows decompression of a stomach full with air from both bag and mask ventilation as well as air swallowed by a distressed patient. Without a gastric tube, the patient may vomit or aspirate on stomach contents. In addition venting of stomach gas will avoid diaphragmatic splinting. A nasogastric tube will increase airway resistance through the nose, which in a spontaneously breathing infant in respiratory failure can be significant. An

Section 8 Advanced life support-gastric tube

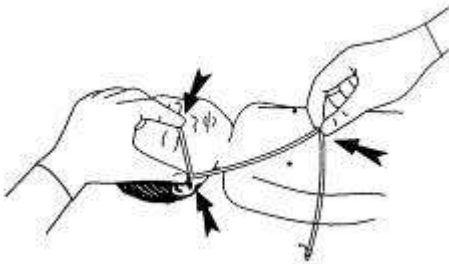
oro-gastric tube has less effect on ventilation but is less easily tolerated and less easily fixed in position.

Equipment

Syringe: Gastric tube: Lubricant (KY jelly or clean water): Stethoscope.
Litmus paper: Adhesive tape.

Procedure

- Place supine with head in 'sniffing' position.



Measure length of tube-from nose or mouth via earlobe to mid-point between xiphoid and umbilicus.

Feed tube lubricated with KY jelly or 0.9% Saline through either nose or mouth directly backwards. (The neonate is a nose breather and therefore the oral route is preferred).

- Try to advance tube as patient swallows. If infant has respiratory distress, oro- gastric tube is best. If passed through nose increases upper airway resistance.

Check position of tube by aspirating stomach contents and checking a change in the litmus paper (blue to pink), or flush the tube with 2 to 3ml air (only 1ml in neonate) and listen over stomach. If in doubt Xray chest/abdomen. NB: acidity of gastric fluid may be reduced in preterm infants

and record length of tube outside nose or mouth.

Secure the tube by taping it to cheek

Measuring Blood glucose

Blood can be used from: samples taken for malarial screen etc – don't remove from bottle containing EDTA. Only require one drop

Capillary sample

- Source needs to be warm and well-perfused.
- Area needs to be clean (sugar free!) – but make sure alcohol has evaporated as this can confuse results.
- Using Vaseline (petroleum jelly) rubbed over skin makes drops easier to collect.
- Suitable areas include finger pulp and earlobes (sides of heels in neonate).

Section 8 Advanced life support-lumbar puncture and blood glucose measurement

- If available use lancet/"tender-touch" etc. If an ordinary needle is used puncture skin at angle of 45 degrees to avoid unnecessarily deep wound.
- Squeeze GENTLY to gain drop.
- If using "BMstix" or "Dextrostix" check they have not expired, are dry and not discoloured. You can use one stick for more than one test if it is cut lengthways before use. Cover indicator mark with drop (do not smear). Wait one minute before wiping off drop and reading against the colour chart on tube.
- For Neonates readings are not reliable below 5 – if any doubt, treat as hypoglycaemia. Generally, hyperglycaemia if >10 and **hypoglycaemia if < 2.5 mmol/litre (45mg/dl)**.
- Normal values – 3.3 - 5.5 mmol/l (63-99 mg/dl).

Lumbar puncture

Dangerous in the presence of raised intra-cranial pressure

Beware if blood clotting disorder (eg. platelets $<80 \times 10^9$ /litre).

Excessive neck flexion when positioning can lead to hypoxaemia and acute respiratory deterioration.

If spinal needle is unavailable and a normal (non-stylet) needle is used, the needle bore may become blocked with skin on insertion and hence not flow. There is also risk of tissue implantation leading to dermoid cyst.

Advance needle slowly. Subarachnoid space is only 0.5 to 0.7 cm below skin in premature infants and 1 cm in babies; hence over-penetration is an easy mistake. Over-penetration leads to puncturing of anterior vertebral venous plexus and a bloody sample, so that CSF microscopy is less informative or impossible.

Equipment

Skin prep, sterile gloves, sterile dressings pack, spinal needle with stylet (in poorly resourced healthcare facilities an ordinary 18-22 gauge needle may be used), small sterile dressing.

Indications

Positioning for lumbar puncture

- To diagnose meningitis.
- As part of a septic screen (especially in infants).

Procedure

- Full surgical asepsis must be undertaken.
- Position patient on the edge of the examination table in lateral decubitus or sitting up. An experienced assistant to hold patient is helpful. Flex spine maximally whilst avoiding excessive neck flexion.
- Clean the lumbar area with skin prep. Drape with sterile towels.
- Identify site of insertion: L4 to L5 lumbar space (on level with iliac crests).



Section 8 Advanced life support-lumbar puncture and blood glucose measurement

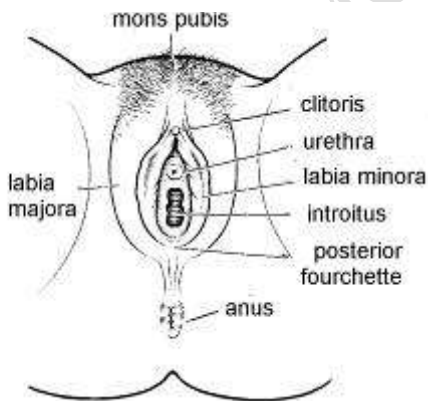
- Slowly insert spinal needle in midline, aiming towards umbilicus.
- Stop advancing when "give"/puncture sensation is felt on entering subarachnoid space (often not felt in neonates). May have to do frequent stylet withdrawals during procedure to see if CSF flows, this is to ensure that subarachnoid space has been successfully entered.
- Withdraw stylet. Allow 6 drops of CSF to drip into each sample container.
- Replace stylet.
- Withdraw needle and swab puncture site with skin prep.
- Cover site with sterile dressing.
- Send samples for
- microbiology (gram stain, mycobacterium culture if suspected, microscopy, cell counts, culture and sensitivity).
- glucose and protein.
-

Urethral Catheterisation

Indications:

- To collect sample (eg infant – can be removed once sample obtained)
- Where no spontaneous urine output
- If continuous urine output measurement is required

Caution: Signs of urethral damage should be excluded first before urethral catheterization (eg blood at external meatus or bruising to the scrotum or perineum). If any doubt, or in cases of abdominal / pelvic injury, decision to catheterize must be decision of surgeon.



Methods

Use appropriate size of catheter i. e. one that is smaller in diameter than the external urethral meatus (risk of subsequent urethral stricture formation). Sterile NGT can also be used – there is a risk of it falling out, but with critically ill child this is adequate if taped to penis and medial aspect of thigh and patient nursed carefully. Do not attempt to use a tube larger than the meatus. If male patient conscious (esp older children) use lidocaine gel if available.

Lubricants should be used even in unconscious patients.

Use sterile precautions (gloves etc), wash area, have sterile pot to hand to take sample, large syringe or catheter bag if available, syringe of water to inflate balloon if is Foley balloon catheter and an assistant to hold legs away

With male hold glans penis securely; there is no need to try and retract foreskin for child less than 3 years. No need for force. Catheter is in sufficiently far when urine is seen in tube.

Rectal Administration of Drugs

In conscious patient explain what you are going to do – it should not be painful. Need consent from an older child.

In most situations rectal quills will not be available so a large NGT cut to about 7 cm, attached to syringe, can be used.

Patients should be on their side with legs bent (“fetal position”) – ask the mother or an assistant to help hold patient in that position.

If KY jelly etc available place on index finger of gloved hand, open anal margin gently and cut end of NGT, advance tube as far as possible, inject drug whilst holding buttocks together.

Keeping plunger of syringe advanced withdraw the syringe and NGT whilst keeping buttocks together.

Continue holding buttocks together for 2 minutes more

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Section 9 Management of cardiac arrest

Cardiac arrest has occurred when there is no effective cardiac output. Before any specific therapy is started effective basic life support must be established as described in Section 6. Four cardiac arrest rhythms can occur:

1. Asystole
2. Pulseless electrical activity (including electro mechanical dissociation)
3. Ventricular fibrillation
4. Pulseless ventricular tachycardia

The four are divided into two groups: two that do not require defibrillation (called “non-shockable”) and two that do require defibrillation (“shockable”). Only non-shockable rhythms will be discussed here.

Non-shockable cardiac arrest (asystole and pulseless electrical activity).

Asystole

This is the most common arrest rhythm in children and **pregnant women or girls**. The response of the young heart to prolonged severe hypoxia and acidosis is progressive bradycardia leading to asystole.

The ECG will distinguish asystole from ventricular fibrillation, ventricular tachycardia and pulseless electrical activity. The ECG appearance of ventricular asystole is an almost straight line; occasionally P-waves are seen. Check that the appearance is not caused by an artifact e.g. a loose wire or disconnected electrode. Turn up the gain on the ECG monitor.



Asystole

Pulseless Electrical Activity (PEA)

This is the absence of a palpable pulse or other signs of circulation despite the presence on the ECG monitor of recognisable complexes which normally produce a pulse. PEA is treated in the same way as asystole and is often a pre-asystolic state.

Section 9 Cardiac arrest

PEA may be due to an identifiable and reversible cause. In children and in pregnancy there are reversible causes; severe hypovolaemia, tension pneumothorax or pericardial tamponade. PEA is also seen in hypothermic patients and in patients with electrolyte abnormalities. It may be seen after massive pulmonary thromboembolus.

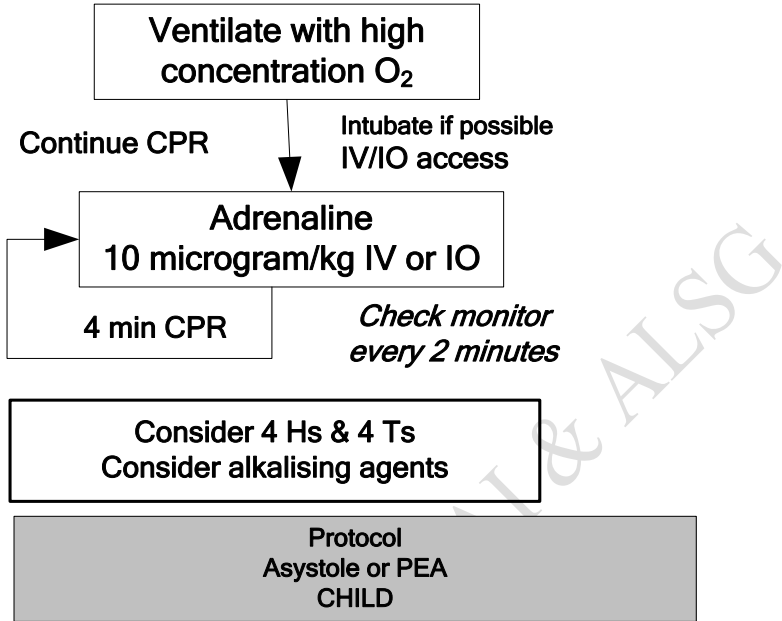
Management of Asystole/PEA

First establish ventilations and chest compressions effectively. Ensure a patent airway, initially using an airway maneuver to open the airway and stabilising it with an airway adjunct. Ventilations are provided initially by bag and mask with high concentration oxygen.

Provide effective chest compressions at a rate of 100 per minute with a compression/ventilation ratio of 15: 2 for an infant or child and 30:2 in pregnancy. Ideally a cardiac monitor is attached and if there are more than one health worker present, **continue chest compressions without pausing during ventilation.**

If asystole or PEA is identified give **adrenaline 10 micrograms per kilogram** (0.1 ml of 1:10,000 solution/Kg) **intravenously or intra-osseously in a child and 1mg IV in pregnancy.** Adrenaline increases coronary artery perfusion and enhances the contractile state of the heart and stimulates spontaneous contractions. This is best given through a central line but if one is not in place it may be given through a peripheral line. Where there is no existing IV access the IO route is recommended as the route of choice as it is rapid and effective. In each case the adrenaline is followed by a normal saline flush (2 to 5 mls).

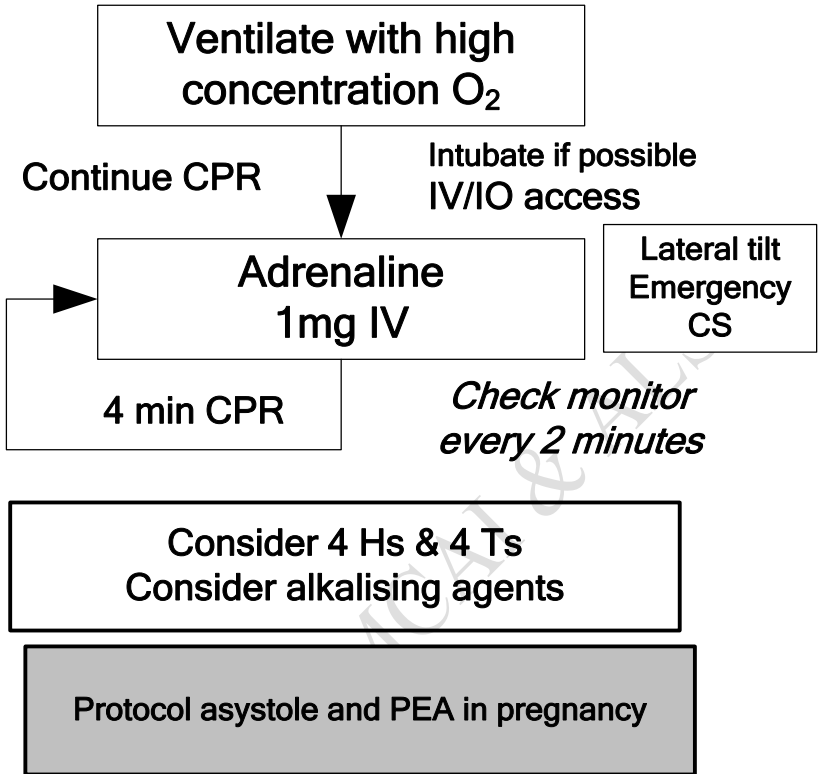
If available, and as soon as is feasible, a skilled and experienced operator should **intubate the patient's airway.** This will both control and protect the airway and enable chest compressions to be given continuously, thus improving coronary perfusion. Once the patient has been intubated and compressions are uninterrupted, the ventilation rate should be 10 per minute. It is important for the team leader to assess that the ventilations remain adequate when chest compressions are continuous.



**** IV atropine after first dose of adrenaline if asystole once only**

During and following adrenaline, chest compressions and ventilations should continue. Giving chest compressions is tiring for the operator so if others are available change regularly.

At intervals of about 2 minutes briefly pause in the delivery of chest compressions to assess the rhythm on the monitor. If asystole remains, continue CPR while again checking the electrode position and contact. If there is an organised rhythm, check for a pulse or signs of a circulation. If there is a return of spontaneous circulation, continue post-resuscitation care. If there is no pulse and no signs of a circulation, continue the protocol. Give adrenaline about every 4 minutes at a dose of 10 micrograms per kilogram IV/IO in a child and 1mg IV in a pregnant woman or girl. If asystole, or in the pregnant woman or girl slow PEA (< 60bpm), give one dose of IV/IO atropine (3mg in the pregnant woman or girl and 20micrograms/Kg in the child –maximum here 600 micrograms) as soon as possible to prevent severe vagal effects.



*** IV atropine after first dose of adrenaline if asystole or PEA rate < 60bpm once only*

Reversible causes

Sometimes cardiac arrest is due to an identifiable and reversible cause, such as shock from massive haemorrhage. In the trauma setting cardiac arrest may be caused by severe hypovolaemia, tension pneumothorax and pericardial tamponade.

It is appropriate to give an early IV bolus of Ringer-Lactate or Hartmann's (20 mls/kg in a child and 500ml to 1 litre in a pregnant woman or girl - depending on her weight) as this will be supportive in cases related to severe hypovolaemia. In addition, however, a tension pneumothorax and/or pericardial tamponade require definitive treatment. Continuing blood replacement and the stopping of haemorrhage may also be required.

Section 9 Cardiac arrest

Rapid identification and treatment of reversible causes such as hypovolaemic shock, hypothermia, electrolyte and acid-base disturbance, tension pneumothorax and pericardial tamponade are vital.

Continually, during CPR, **consider and correct reversible causes** of the cardiac arrest based on the history of the event and any clues that are found during resuscitation.

The 4Hs and 4Ts:

Hypoxia is a prime cause of cardiac arrest in childhood and is key to successful resuscitation. **Hypovolaemia** may be significant in arrests associated with trauma, gastroenteritis, pregnancy related haemorrhage, anaphylaxis and sepsis and requires infusion of crystalloid or, if haemorrhage, give blood.

Hyperkalaemia, hypokalaemia, hypocalcaemia, acidaemia and other metabolic abnormalities may be suggested by the patient's underlying condition (e.g. renal failure), tests taken during the resuscitation or clues given in the ECG (see CD/DVD rom). Intravenous calcium (0.2 mls/kg of 10% calcium gluconate) is indicated in hyperkalaemia and hypocalcaemia.

Hypothermia is associated with drowning incidents and requires particular care and a low reading thermometer must be used to detect it (see CD/DVD rom).

Tension pneumothorax and cardiac **tamponade** are especially associated with PEA and are often found in trauma cases.

Toxic substances, either as a result of accidental or deliberate overdose or from a iatrogenic mistake, may require specific antidotes.

Thromboembolic phenomena (pulmonary or amniotic fluid) in pregnancy.

Drugs in Cardiac Arrest

Adrenaline is the first line drug for cardiac arrest

The initial IV or IO dose is 10 micrograms/kg (0.1 ml/kg of 1:10,000 solution) in a child and 1mg (1ml of 1 in 1000 solution) in a pregnant woman or girl. In the child with no existing IV access, the intraosseous route is recommended as the route of choice as it is rapid and effective. In each case adrenaline is followed by a 0.9% saline flush (2 to 5mls).

Sodium Bicarbonate

Good basic life support is more effective than alkalizing agents, which may be considered if spontaneous circulation has not returned after the first or second dose of adrenaline. It is recommended in the treatment of patients with hyperkalaemia and tricyclic antidepressant overdose.

The dose is 1 mmol/kg in a child (1 ml/kg of an 8.4% solution or 2ml/kg of 4.2% solution) or 50mmol in a pregnant woman or girl.

- Bicarbonate must not be given in the same intravenous line as calcium because precipitation will occur.
- Sodium bicarbonate inactivates adrenaline and dopamine and therefore the line must be flushed with saline if these drugs are subsequently given.
- Bicarbonate must not be given by the intra-tracheal route.

Section 9 Cardiac arrest

Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl))

All patients, especially infants and pre-school age children, can become hypoglycaemia when seriously ill. Blood glucose should be checked frequently and **hypoglycaemia must be corrected**. If suspected and blood glucose cannot be measured always give 5ml/kg 10% glucose in a child or 50 ml of 25% glucose in pregnancy, preferably IV if not enterally (gastric tube). If blood glucose levels can be measured then avoid hyperglycaemia (blood glucose >12mmol/l).

In pregnancy to make 25% glucose add 50ml of 50% glucose to 50ml of 0.9% saline or Ringer-Lactate or Hartmann's

Cardiac arrest and cardiopulmonary resuscitation in the obstetric patient

Background

Cardiac arrest in late pregnancy or during delivery is rare and maternal survival is very low (3-33% in published series). The cause of the arrest is not often reversed and the physiologic changes present in late pregnancy hinder effective CPR.

Cardiac arrest in the pregnant woman or girl results in absent uterine perfusion and the fetus will also die. Even when CPR is ideal, it is not possible to generate a cardiac output of more than 30%.

Causes include

Massive haemorrhage
Pulmonary embolism
Trauma
Amniotic fluid embolism
Severe infection
Local anaesthetic toxicity

Physiologic changes of pregnancy as they relate to cardiopulmonary resuscitation

Pregnant women or girls more easily develop hypoxaemia.

The enlarged uterus along with the resultant upward displacement of the abdominal viscera decreases lung compliance.

The most serious is aorto-caval compression in the supine position. During closed-chest cardiac compression the best cardiac output that can be achieved is between one-fourth to one-third of normal. Although many factors contribute to this, poor venous return to the heart is of paramount importance. At term the vena cava is completely occluded in 90 percent of supine pregnant patients. This results in a decrease in cardiac stroke volume of as much as 70%.

CS early in resuscitation vastly improves the effectiveness of maternal resuscitation.

Peri-mortem Caesarean section (CS)

- CS should be performed as soon as possible. This will immediately relieve the vena caval obstruction and increase the chance of survival for both infant and pregnant woman or girl. CPR must be continued throughout the procedure until spontaneous and effective cardiac activity occurs.
- Assisted ventilation may have to be continued for a longer period of time. Some infants have survived when delivered after 20 minutes of maternal resuscitation.

Section 9 Cardiac arrest

- Without CS <10% arresting in hospital will survive to discharge. Removal of the infant improves maternal circulation during resuscitation – cardiac output immediately increases 20 – 25%.

Perform the CS with a midline vertical incision, or whatever the operator is most used to doing, and remove the baby as fast as possible. Remove lateral tilt when baby is delivered.

When to stop resuscitation (local guidelines should be in place)

Resuscitation efforts are unlikely to be successful, and can be discontinued, if there is no return of spontaneous circulation at any time after 30 minutes of cumulative life support and in the absence of recurring or refractory VF/VT. Exceptions are patients with a history of poisoning or a primary hypothermic insult where prolonged attempts may occasionally be successful. Prolonged external cardiac compressions during which central (femoral or arterial) pulses were felt has successfully resuscitated children with tricyclic antidepressant overdoses.

The presence of relatives at the patient's side during resuscitation enables them to gain a realistic understanding of the efforts made to save their loved one's life.

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SECTION 10 Structured approach to the seriously ill infant, child or pregnant woman or girl

Assessment and resuscitation occur at the same time. The order of assessment and resuscitation enables identification of immediately life threatening problems, which are treated as they are found.

Primary assessment during emergencies

Airway/Breathing/Circulation/Disability ABCD

Primary Assessment of the Airway

Vocalisations, such as crying or talking, indicate ventilation and some degree of airway patency.

Assess patency by

Looking for chest and/or abdominal movement

Listening for breath sounds

Feeling for expired air

Reassess after any airway opening manoeuvres – ie jaw and neck positioning

In addition, note other signs that may suggest upper airway obstruction:

- the presence of stridor
- evidence of recession

Give oxygen throughout this time

Consider suction and foreign body removal and oro- or naso- pharyngeal airway

Consider intubation and surgical cricothyroidotomy if all else fails and the upper airway is severely obstructed

Primary assessment of Breathing

Respiratory rate (make count over 1 minute when patient is calm)

Rates “at rest” at different ages are:

Age (yrs)	Respiratory rate
<1	30-40
1-2	25-35
2-5	25-30
5-12	20-25
>12 and Pregnancy	15-20

Care should be taken in interpreting single measurements: infants can show rates of between 30 and 90 breaths per minute depending on their state of activity. More useful are trends in measurements as an indicator of improvement or deterioration.

WHO definitions of Fast Breathing are:

< 2 months	is \geq 60 breaths per minute
2 – 12 months	is \geq 50 breaths per minute
12 months to 5 years	is \geq 40 breaths per minute

Tach

ypnoea – from either airway or lung disease or metabolic acidosis

Bradypnoea – due to fatigue, raised intracranial pressure, or pre-terminal

Recession

- intercostal, sub-costal or sternal recession shows increased effort of breathing (particularly seen in infants with more compliant chest walls)
- degree of recession indicates severity of respiratory difficulty
- in the patient with exhaustion, chest movement and recession will decrease

Inspiratory or expiratory noises

- stridor, usually inspiratory, indicates laryngeal or tracheal obstruction
- wheeze, predominantly expiratory, indicates lower airway obstruction
- volume of noise is not an indicator of severity

Grunting

- seen in infants and children with stiff lungs to prevent airway collapse (represents closure of the larynx during expiration)
- is a sign of severe respiratory distress

Accessory muscle use

In infants the use of the sternocleidomastoid muscle creates “head bobbing” and is ineffectual

Flaring of alae nasi

Gasping

A sign of severe hypoxaemia and may indicate impending respiratory arrest and death

Exceptions

Increased effort of breathing DOES **NOT** OCCUR in 3 circumstances:

1. exhaustion
2. central respiratory depression eg. from raised intracranial pressure, poisoning or encephalopathy
3. neuromuscular disease eg. poliomyelitis

Efficacy of breathing

Breath sounds on auscultation

1. reduced or absent
2. bronchial
3. symmetrical or asymmetrical

Chest expansion (**most important**) / abdominal excursion

Pulse oximetry (normal oxygen saturation (SaO₂) in a patient at sea level is 95 – 100% in air).

Effects of breathing failure on other physiology

Heart rate Increased by hypoxia, fever or stress and by pregnancy

Bradycardia with hypoxia is a sign of impending cardio-respiratory arrest

Skin colour

Hypoxia first causes vasoconstriction and pallor

Cyanosis is a late sign and may indicate impending cardio-respiratory arrest

Mental status

Hypoxic child will be agitated first, then drowsy, then unconscious

Pulse oximetry may be difficult to measure in the agitated patient

Primary assessment of Circulation

Circulatory status: Heart rate

Heart rate increases in shock. Bradycardia may be a sign of imminent cardio-respiratory arrest.

Section 10 Structured approach

Rates "at rest" at different ages are:

Age (yrs)	Heart rate (beats/min)
<1	110-160
1-2	100-150
2-5	95-140
5-12	80-120
>12	60-100
Pregnancy	65-115

WHO definitions for tachycardia are: > 160 bpm aged under 1 year and >120 bpm aged 1 to 5 years.

Heart rates in pregnancy are increased by 10-15% (65-115 beats/min)

Circulatory status: Pulse volume

Absent peripheral pulses or reduced central pulses can indicate shock

Circulatory status: Capillary refill

Pressure on the centre of the sternum or fingernail for 5 seconds should be followed by return of the circulation to the skin within ≤ 3 seconds. May be prolonged by shock, cold environment, or the vasoconstriction that is present as a fever develops. *Not a specific or sensitive sign of shock* Should not be used alone as a guide to the response to treatment

Circulatory status: Blood pressure

Cuff should cover at least 80% of the length of the upper arm, and the bladder more than two thirds of the arm's circumference (in pregnancy to avoid missing a raised blood pressure the largest possible cuffs should be used).

Korotkoff 5 sounds (disappearance) should be used for measuring diastolic pressure. K4 sound should only be used if the sound does not disappear until near zero.

Hypotension is a late sign of circulatory failure in both children and pregnant woman or girl and will rapidly be followed by cardio-respiratory arrest unless treated urgently

Blood pressure may increase in pregnancy and be accompanied by proteinuria and oedema.

Age (yrs)	Systolic blood pressure	Diastolic blood pressure
<1	70-90	
1-2	80-90	
2-5	80-95	
5-12	90-110	
>12	100-120	
Pregnancy	90-120	50-70

Blood pressure is a difficult measure to obtain and interpret especially in infants and children <5 years. A formula for calculating normal systolic blood pressure in children is

The cardiovascular system in a child and **pregnant woman or girl** compensates well initially in shock. **Hypotension is a late and often sudden sign of decompensation and, if not reversed, will be rapidly followed by death.** Serial measurements of blood pressure should be performed frequently

Circulatory status: Effects of circulatory inadequacy on other organs

Respiratory system – tachypnoea and hyperventilation occurs with acidosis eg. poor tissue perfusion

Skin – pale or mottled skin indicates poor perfusion

Mental status – agitation, then drowsiness, then unconsciousness

Urine output - <2ml/kg/hour in infants <1ml/kg/hour in a child <30ml/hour in pregnancy indicates inadequate renal perfusion

On uterus can lead to fetal compromise

Cardiac failure: Features suggesting cardiac cause of respiratory inadequacy

Cyanosis, not corrected with oxygen therapy
Tachycardia out of proportion to respiratory distress
Raised jugular venous pressure
Gallop rhythm
Enlarged liver
Absent femoral pulses in an infant or child
Basal lung crepitations

Primary assessment of Disability

Always assess and treat **A**irway, **B**reathing and **C**irculatory problems before undertaking neurological assessment.

Neurological function

Conscious level: AVPU

A	ALERT
V	responds to VOICE
P	responds to PAIN
U	UNRESPONSIVE

If the patient does not respond to voice it is important that assessment of the response to pain is undertaken. A painful central stimulus can be delivered by sternal pressure, by supra-orbital ridge pressure or by pulling frontal hair. A patient who is unresponsive or who only responds to pain has a significant degree of coma.

Posture

Section 10 Structured approach

Many patients who are suffering from a serious illness in any system are hypotonic. Stiff posturing, such as that shown by decorticate (flexed arms, extended legs) or decerebrate (extended arms, extended legs), are signs of serious brain dysfunction. *These postures can be mistaken for the tonic phase of a convulsion.* Alternatively a painful stimulus may be necessary to elicit these postures.

Severe extension of the neck due to upper airway obstruction can mimic the opisthotonus that occurs with meningeal irritation. A stiff neck and full fontanel in infants are signs which suggest meningitis.

Pupils

Many drugs and cerebral lesions have effects on pupil size and reactions. However, the most important pupillary signs to seek are dilatation, unreactivity, and inequality, which indicate possible serious brain disorders.

Check blood glucose. **Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) can cause unconsciousness**

<i>Raised Intracranial Pressure may cause:</i>
<i>Hyperventilation</i>
<i>Slow sighing respirations</i>
<i>Apnoea</i>
<i>Hypertension</i>
<i>Bradycardia</i>

Respiratory effects of central neurological failure

The presence of any abnormal respiratory pattern in a patient with coma suggests mid- or hind-brain dysfunction.

Circulatory effects of central neurological failure

Systemic hypertension with sinus bradycardia (Cushing's response) indicates compression of the medulla oblongata caused by herniation of the cerebellar tonsils through the foramen magnum. *This is a late and pre-terminal sign.*

Assessment by Exposure

Although not part of the primary assessment, the examination of the seriously ill patient will involve examination for markers of illness that will help provide specific emergency treatment.

Temperature

A fever suggests an infection as the cause of the illness, but may also be the result of prolonged convulsions or shivering.

Rash

Examination is made for rashes, such as urticaria in allergic reactions, purpura, petechiae and bruising in septicaemia, child abuse or partner violence, or maculo-papular and erythematous rashes in allergic reactions and some forms of sepsis.

Summary

The whole assessment should take less than a minute.

Summary: rapid clinical assessment of an infant, child or pregnant woman or girl

Airway and Breathing

Effort of breathing: Respiratory rate/rhythm: Stridor/wheeze: Auscultation: Skin colour

Circulation

Heart rate: Pulse volume: Capillary refill: Skin temperature

Disability

Mental status/conscious level: Posture: Pupils: Blood glucose

Only when airway, breathing and circulation problems have been recognised and treated should definitive management of underlying condition proceed.

During treatment, **reassessment of ABCD at frequent intervals** will be necessary to assess progress and detect deterioration.

The structured approach to the seriously ill infant, child or pregnant woman or girl

- Primary assessment
- Resuscitation
- Secondary assessment and looking for key features
- Emergency treatment
- Stabilisation and transfer to definitive care

Primary assessment and resuscitation involve management of the vital ABC functions and assessment of disability (CNS function). This assessment and stabilisation occurs before any illness-specific diagnostic assessment or treatment takes place. Once the patient's vital functions are supported, secondary assessment and emergency treatment begins. Illness-specific pathophysiology is sought and emergency treatments are instituted. During the secondary assessment vital signs should be checked frequently to detect any change in the patient's condition. If there is deterioration then primary assessment and resuscitation should be repeated.

RESUSCITATION

Airway

If the airway is not patent, then this can be secured by:

- a chin lift or jaw thrust
- the use of an airway adjunct such as oropharyngeal or nasopharyngeal airway
- tracheal intubation (call for anaesthetist if available)

Breathing

Section 10 Structured approach

Give high-flow oxygen (flow rate 15 l/min) through a non-rebreathing mask with a reservoir bag to any patient with respiratory difficulty or hypoxia.

In the patient with inadequate breathing this should be supported with bag– valve–mask ventilation or intubation and intermittent positive pressure ventilation (if this is available).

Circulation

Give high-flow oxygen to every patient with an inadequate circulation (shock). This will be through either a non-rebreathing mask with a reservoir bag (or an endotracheal tube if intubation has been necessary).

Venous or intraosseous access should be gained and an immediate infusion of crystalloid, colloid or blood as appropriate (20 ml/kg in a child and 500ml to 1 litre in an adult) given. Urgent blood samples may be taken at this point.

FOR A CHILD WEIGHT CAN BE CALCULATED AS FOLLOWS:

Estimate of Weight

Infant = up to 12 months old	
Birth weight	- doubles by 5 months
-	- triples by 1 year
-	- quadruples by 2 years

After 12 months, the formula can be applied, but needs to be modified according to whether the child is small or large compared with the average

$$\text{Weight (Kg)} = 2 \times (\text{age in years} + 4)$$

Disability (Neurological)

Consider intubation (if this is safely available) to stabilise the airway in any patient with a conscious level recorded as P or U (only responding to painful stimuli or unresponsive).

Treat hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) with 5 ml/kg of 10% dextrose after having taken blood for glucose measurement (ideally by both stick tests and in the laboratory).

Intravenous/intraosseous lorazepam, buccal midazolam or rectal diazepam should be given for prolonged or recurrent fits (see below)

SECONDARY ASSESSMENT AND EMERGENCY TREATMENT

The secondary assessment takes place once vital functions have been assessed and the initial treatment of those vital functions has been started. It includes a medical history, a clinical examination and specific investigations. At the end of secondary assessment, the practitioner should have a better understanding of the illness affecting the patient and may have formulated a differential diagnosis. Emergency treatments will be appropriate at this stage – either to treat specific conditions (such as asthma) or processes (such as raised intracranial pressure). The establishment of a definite diagnosis is part of definitive care.

The history often provides the vital clues that help the practitioner identify the disease process and provide the appropriate emergency care. In the case of infants and children the history is often obtained from an accompanying parent, although a history should be sought from the child if possible. Do not forget to ask the first responder about the patient's

Section 10 Structured approach

initial condition and about treatments and response to treatments that have already been given.

Some patients will present with an acute exacerbation/complication of a known condition such as pregnancy, asthma or epilepsy.

The secondary assessment is not intended to complete the diagnostic process, but rather is intended to identify any problems that require emergency treatment.

The following gives an outline of a structured approach in the first hour of emergency management. It is not exhaustive but addresses the majority of emergency conditions that are amenable to specific emergency treatments in this time period.

Airway and Breathing Secondary assessment

Common symptoms	Signs	Emergency investigations
Breathlessness Coryza Tachypnoea Choking Cough Abdominal pain Chest pain Apnoea Feeding difficulties Hoarseness	Bubbly noises in throat Cyanosis Recession Noisy breathing – grunting, stridor Drooling and inability to drink Wheeze Tracheal shift Abnormal percussion note Crepitations on auscultation Acidotic breathing	O2 saturation Blood culture if infection suspect Chest X-ray (selective)

Emergency treatment

- If “bubbly” noises are heard the airway is full of secretions. These may require clearance by suction.
- If in a pre-school child there is a harsh stridor associated with a barking cough and severe respiratory distress upper airway obstruction due to severe croup should be suspected. Give the child oral prednisolone and nebulised adrenaline (5 ml of 1:1000 nebulised in oxygen).
- If there is a quiet stridor and drooling in a sick-looking child consider epiglottitis or tracheitis. Intubation is likely to be urgently required, preferably by an anaesthetist. Do not put the airway at risk by unpleasant or frightening interventions. Give intravenous antibiotics. Surgical airway may be needed so contact a surgeon.
- With a sudden onset and significant history of inhalation consider a laryngeal foreign body. If the “choking” protocol has been unsuccessful the patient may require laryngoscopy. Do not put the airway at risk by unpleasant or frightening interventions but contact an anaesthetist/ENT surgeon urgently. However in extreme, life threatening cases immediate direct laryngoscopy to remove a visible foreign body with Magill’s forceps may be necessary.
- Stridor following ingestion/injection of a known allergen suggests anaphylaxis. Patients in whom this is likely should receive IM adrenaline (10 microgram/kg for a child and 1mg for an adult).

Section 10 Structured approach

- Patients with a history of asthma or with wheeze, significant respiratory distress, and/or hypoxia should receive inhaled *salbutamol* and oxygen. Infants with wheeze and respiratory distress are likely to have bronchiolitis and require oxygen.
- In acidotic breathing take blood glucose. Treat diabetic ketoacidosis with IV 0.9% saline and insulin (sections 10 and 12).

Circulation

Secondary assessment

Common symptoms	Signs	Emergency investigations
Haemorrhage Breathlessness Palpitations Feeding difficulties Abdominal pain Chest pain Apnoea Feeding difficulties Hoarseness Drowsiness	Tachycardia or bradycardia Abnormal pulse volume or rhythm Abnormal skin perfusion or colour Haemorrhage or hidden haemorrhage Severe malnutrition Fever Hypo- or hypertension Cyanosis Pallor Enlarged liver Lung crepitations Poor urine output Cardiac murmur Peripheral oedema Raised jugular venous pressure Low muscle tone Dehydration Purpuric rash	O2 saturation Blood culture if infection suspect Chest X-ray (selective) ECG (selective) HB Urea and electrolytes (if available) Clotting studies (if available) Malarial parasites

Emergency treatment

- Further boluses of fluid should be considered in shocked patients who have not had a sustained improvement to the first bolus given at resuscitation. However in trauma, where there is uncontrolled bleeding, early surgical intervention has priority and too much IV fluids may be harmful.
 - Consider inotropes, intubation and central venous pressure monitoring if available.
 - Consider IV broad spectrum antibiotics in shocked patients with no obvious fluid loss as sepsis is likely.
 - If a patient has a cardiac arrhythmia the appropriate protocol should be followed.
 - If anaphylaxis is suspected give IM adrenaline 10 micrograms/kg in a child, or 1mg in a pregnant woman or girl, in addition to fluid boluses.
 - Targeted treatment for obstetric emergencies known to cause shock (may include urgent surgery).
 - Surgical advice and intervention for certain gastro-intestinal emergencies.
- The following symptoms and signs may suggest intra-abdominal emergencies: vomiting, abdominal pain, abdominal tenderness, rectal bleeding, abdominal mass.

Disability (neurological)

Secondary assessment

Section 10 Structured approach

Common symptoms	Signs	Emergency investigations
Headache Drowsiness Vomiting Change in behavior Visual disturbance	Altered or change in conscious level Convulsions Bradycardia Altered pupil size and reactivity Abnormal postures Meningism Fever Papilloedema or retinal haemorrhage Altered deep tendon reflexes Hypertension	Blood glucose O2 saturation Blood culture if infection suspect HB Urea and electrolytes (if available) Malarial parasites

Emergency treatment

If hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) is possible, treat urgently.

- If convulsions persist treat
- If evidence of raised intracranial pressure (decreasing conscious level, abnormal posturing and/or abnormal ocular motor reflexes) then the child should undergo:
 - Bag valve mask ventilations if apnoea or slow or poor breathing
 - Nursing with head in-line and 20–30 degree head-up position (to help cerebral venous drainage)
- IV infusion with mannitol 250 to 500 mg/kg over 15 minutes, and repeated as needed
- Consider dexamethasone 500 microgram/kg twice daily (for oedema surrounding a space occupying lesion)
- In a child with a depressed conscious level or convulsions consider meningitis/encephalitis. Give antibiotics and acyclovir as appropriate.
- In drowsiness with sighing respirations check blood glucose. Think of salicylate poisoning. Treat diabetic ketoacidosis with IV 0.9% saline and insulin.
- In unconscious patients with pin-point pupils consider opiate poisoning. A trial of naloxone should be given.

External (exposure)

Secondary assessment

Signs
Rash Purpura Swelling of lips/tongue and/or urticaria Fever

Emergency treatment

- In a child with circulatory or neurological symptoms and signs a purpuric rash suggests septicaemia/meningitis or Dengue haemorrhagic fever. The patient should receive IV broad spectrum antibiotics preceded by a blood culture.
- In a patient with respiratory or circulatory difficulty the presence of an urticarial rash or angio-oedema suggests anaphylaxis. Give adrenaline **IM (10 microgram/kg for a child or 1 mg for a pregnant woman or girl)**.

Further history

Section 10 Structured approach

Developmental and social history

Particularly in a small child or infant knowledge of the child's developmental progress and immunisation status may be useful. The family circumstances may also be helpful, sometimes prompting parents to remember other details of the family's medical history.

Drugs and allergies

Any medication that the patient is currently, or has been, on should be recorded. In addition ask about any medication in the home that a child might have had access to if poisoning is a possibility. A history of allergies should be sought.

SUMMARY

The structured approach to the seriously ill patient outlined here allows the practitioner to focus on the appropriate level of diagnosis and treatment during the first hour of care. Primary assessment and resuscitation are concerned with the maintenance of vital functions, while secondary assessment and emergency treatment allow more specific urgent therapies to be started. This latter phase of care requires a system-by-system approach and this minimises the chances of significant conditions being missed.

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SECTION 11 Medical emergencies in pregnancy

THE pregnant woman or girl WITH SPECIFIC AIRWAY AND BREATHING PROBLEMS

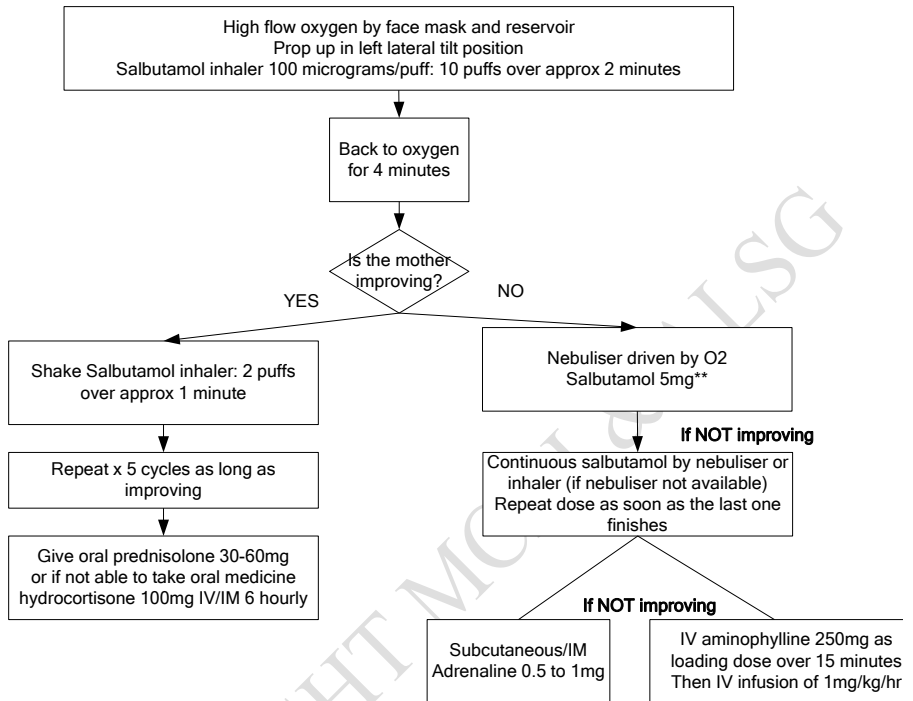
Severe Bronchial Asthma

Assessment

Features of severe asthma	Features of life-threatening asthma
too breathless to eat or talk	conscious level depressed / agitated
recession/use of accessory muscles	exhaustion
respiratory rate >40 breaths/min	poor respiratory effort
pulse rate >120 beats/min	SaO ₂ < 85% in air / cyanosis
	silent chest

- Bronchial asthma complicates 3–4% of pregnancies. Pregnancy is associated with worsening of the symptoms in one-third of affected women or girls.
- A CXR is indicated only if there is severe difficulty in breathing, uncertainty about the diagnosis, asymmetry of chest signs (possible pneumothorax) or signs of severe infection.
- Continuous pulse oximetry is valuable (if available) since hypoxaemia is a major feature of all severe asthma attacks.
- Avoid prostaglandins. For the prevention and treatment of post partum haemorrhage give oxytocin 10 units IM and ergometrine 500 micrograms IM

Severe Asthma – Pathway of Care in pregnancy



** Salbutamol may inhibit uterine contractions

If not responding, or deteriorating condition

1. Nebulised salbutamol may be given continuously.
2. In those with poor respiratory effort, depressed conscious level and poor oxygenation despite maximum oxygen therapy
 - attempt to support ventilation with bag-valve-mask
 - summon experienced support if available and consider intubation for mechanical ventilation with IV ketamine induction

Other measures

- Reassure patient, avoid upset
- IV fluids - restrict to two-thirds of the normal requirements
- Antibiotics - give only if there are clear signs of infection
- When recovered review maintenance treatment and inhaler technique

Lower respiratory tract infection

Always consider HIV infection, the resulting opportunistic infections and tuberculosis.

A high fever usually means pneumonia, epiglottitis or bacterial tracheitis. In the absence of stridor and wheeze, breathing difficulties in association with a significant fever are likely to be due to pneumonia.

Pleuritic chest pain, neck stiffness and abdominal pain may be present if there is pleural inflammation. Pleural effusions and empyema are complications of pneumonia.

Emergency treatment

- Assess ABC
- High concentration of **oxygen** via a facemask with **reservoir bag**. Attach pulse oximetry
 - If a low flow maintains $\text{SaO}_2 > 94\%$ then nasal cannulae may be used with a flow up to 2 l/min
- Antibiotics - cefuroxime \pm fluxcloxacillin (for staph aureus), erythromycin (for chlamydia or mycoplasma pneumonia) or whatever is available locally and is appropriate
- Sit upright in left lateral tilt
- Maintain hydration
 - extra fluid may be needed to compensate for fluid loss from fever
 - restriction may be needed because of inappropriate ADH secretion
- Chest x-ray is indicated
 - large pleural effusions/empyemas should be diagnosed where possible by ultrasound and pleural drainage under ultrasound cover (beware of placing chest drain into the heart, liver or an undiagnosed tumour or hydatid cyst).
Remember that in advanced pregnancy the diaphragm is elevated.
- Effusions/empyemas adjacent to the heart on the left side may cause pericarditis and arrhythmias (listen regularly for pericardial rub and ideally monitor ECG until stable)

Heart Failure

Assessment

Features suggesting a cardiac cause of breathing difficulty

- cyanosis, not correcting with O_2
- tachycardia out of proportion to respiratory difficulty
- raised jugular venous pressure
- gallop rhythm / murmur
- enlarged liver
- basal lung crepitations

Rheumatic Heart Disease

This is a common cause of heart failure in the pregnant woman or girl. The risk of heart failure is increased by anaemia.

Damage to the heart valves increases the chance of sub-acute bacterial endocarditis so that any invasive procedures and labour should be covered by antibiotics (1gm amoxycillin plus 120 mg gentamicin IM). If the pregnant woman or girl is allergic to amoxycillin an IV infusion of vancomycin (1gm over 60 minutes) plus gentamicin (120 mg IV) is an alternative.

Section 11 Medical emergencies in pregnancy-pneumonia, heart failure, severe anaemia

Treatment

- Assess ABC
- High concentration of oxygen via facemask with reservoir bag
- If there are signs of pulmonary congestion or a large heart on chest x-ray give IV frusemide 40mg (and repeat as required). Venesection may be required.
- If severely anaemic a partial exchange transfusion may help. Careful transfusion of packed cells, with 40mg IV frusemide for each unit of packed cells, will almost always be required.
- Morphine 10mg IM
- Sit upright on left side
- Bed rest
- Consider digoxin
- Consider nitroglycerine 300 micrograms under the tongue, repeated in 15 minutes, if necessary

Management of heart failure during labour

MAKE SURE THE pregnant woman or girl DELIVERS SITTING UP.

Give her oxygen from a face mask.

Prop up in the left lateral tilt position.

Limit infusion of IV fluids, to decrease the risk of circulatory overload, and maintain a strict fluid balance chart.

Ensure adequate analgesia.

If oxytocin infusion is required, use a higher concentration at a slower rate while maintaining a fluid balance chart (e.g. the concentration may be doubled if the drops per minute are decreased by half). Consider early reduction of oxytocin when contractions become established.

Increase the rate of oxytocin infusion only to the point where good labour is established and then maintain infusion at that rate.

Do not give ergometrine.

Have the pregnant woman or girl avoid sustained bearing down efforts during the second stage, if possible.

Perform an episiotomy and assist delivery by vacuum extraction or forceps.

Ensure active management of third stage.

Heart failure is not an indication for Caesarean section.

Severe Anaemia

In normal pregnancy there is an increased total blood volume and a marked increase in plasma, thus haemoglobin concentration falls. Pathological anaemia is mainly due to iron deficiency, associated with depleted iron stores before pregnancy and poor diet. Anaemic women cope poorly with blood loss at delivery. Oral iron supplementation is advised during all pregnancies. It is particularly important in the woman or girl who is anaemic before pregnancy or who has a poor diet. WHO recommends an iron supplement of 60 mg per day for pregnant women or girls with adequate iron stores and 120mg/ day for those with none. If oral therapy is not tolerated, or is not possible, give 250mg IM monthly x 3.

- Treat any malaria, consider and prevent future inoculations with impregnated bed nets etc.
- Treat any chronic parasitaemia eg hookworm or schistosomiasis.
- Genetic blood disorders such as thalassaemia and sickle cell syndrome may be causes of chronic anaemia and may be passed on to the fetus. Check for these using Hb Electrophoresis.

Section 11 Medical emergencies in pregnancy-pneumonia, heart failure, severe anaemia

- **Severe anaemia exists if Hb < than 5 g/dl** or if there are signs of heart failure and Hb is <7.5g/dl. It is very dangerous for both pregnant woman or girl and baby.
- In haemolysis the urine will usually be dark brown in colour.
- The patient will be weak, with palms, soles and tongue near white, and signs of heart failure
- If heart failure give high concentration of oxygen, bed rest and sit upright on left side
- A transfusion of 500ml whole blood or 1 unit (330 ml) of packed cells can increase the Hb by 1 gm/dl. Transfusion with packed cells is optimal when the Hb is less than 5 g/dl. If blood cannot be centrifuged let the bag hang until the cells have settled. Infuse the cells slowly and dispose of the remaining serum.
- **Give 40 mg frusemide IV with each unit of blood transfused.**
- Partial exchange transfusion may be safer
- Over-hydration may lead to pulmonary oedema

IF LABOUR occurs when severely anaemic

- deliver sitting up in left lateral position
- Cross match blood in case of subsequent post partum haemorrhage
- Consider shortening the second stage by using a ventouse
- Manage the third stage actively (give oxytocin) and suture any tears without delay
- The pregnant woman or girl is in danger for at least 24 hours after delivery
- After delivery the store of iron in her body will probably not be normal, so give her iron 120mg/day for 3 months and folate 400 micrograms/day during the puerperium.

Anaphylaxis

Assessment

An allergic reaction to ingested, inhaled or topical substances, which may present as either shock or respiratory distress. Common causes include allergy to penicillin, radiographic contrast media, latex and certain foods, especially nuts.

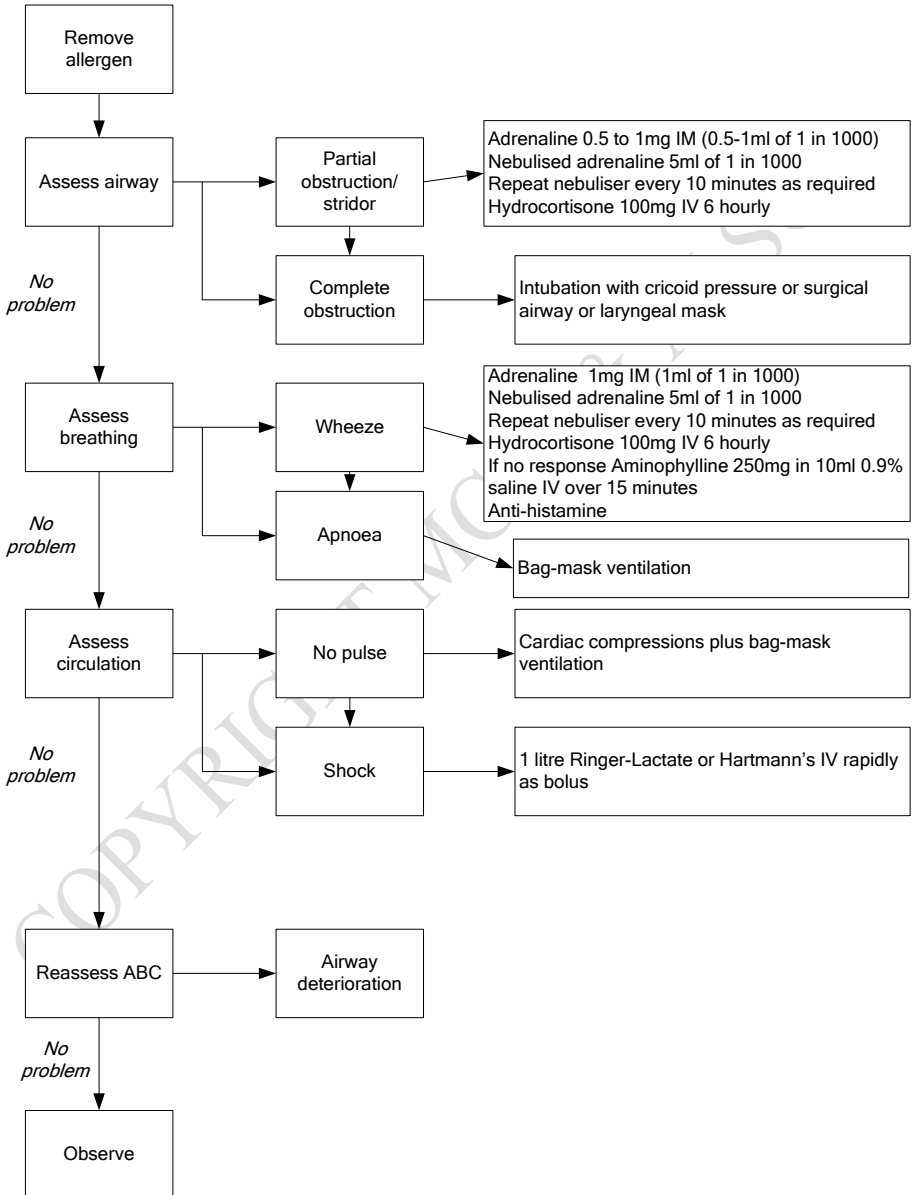
This situation is potentially life-threatening and may result in: change in conscious level, collapse, respiratory or cardiac arrest. Some patients may carry their own adrenaline.

Note: Adrenaline 1mg is given IM, unless intractable shock or cardiac arrest on presentation when give the same dose IV

Moderate to severe anaphylaxis symptoms

	Moderate	Severe
Symptoms	<ul style="list-style-type: none"> - Coughing/ wheezing - Loose bowel motions - Sweating - Irritability 	<ul style="list-style-type: none"> - Difficulty breathing - Collapse - Vomiting - Uncontrolled defaecation
Signs	<ul style="list-style-type: none"> - Bronchospasm - Tachycardia - Pallor 	<ul style="list-style-type: none"> - Severe bronchospasm - Laryngeal oedema - Shock - Respiratory arrest - Cardiac arrest

Pathway of care for Anaphylaxis in pregnancy



Pulmonary embolism

Risk factors include operative delivery, prolonged labour, instrumental vaginal delivery, the pregnant woman or girl > 35 years and obesity.

Signs and symptoms of pulmonary embolism

Findings	Patients with proven Pulmonary embolism (%)
Tachypnoea	89
Dyspnoea	81
Pleuritic pain	72
Apprehension	59
Cough	54
Tachycardia	43
Haemoptysis	34
Temperature >37 ⁰ C	34

Physical findings may be few. Prevention with anti-embolism stockings and subcutaneous heparin for medium and high-risk women, particularly if they are immobilised, is important.

Management

- Suspect pulmonary embolism in all patients presenting with sudden onset of shortness of breath, chest pain, unexplained rapid heartbeat or cardiovascular collapse.
- Call senior obstetrician, anaesthetist and medical team (if available)
- Assess and ensure adequate **A**irway, **B**reathing and **C**irculation
- Transfer the patient to a high dependency area and commence non-invasive monitoring of blood pressure, pulse oximetry, ECG and urine output. Send the blood for full blood count. Request chest x-ray and ECG.
- Treat any suspected pulmonary embolism (confirmatory tests are unlikely to be available).
- Patients in shock should be referred, when possible, for expert and intensive management such as intubation, ventilation, inotropes and more intensive monitoring.
- Commence anticoagulation. Treatment should be commenced with Low Molecular Weight Heparin (LMWH) such as enoxaparin given subcutaneously. The drug is available in syringes of 40, 60, 80 and 100 mg. The dose closest to the patient's pre-pregnancy weight should be given 12 hourly (for example if weight is 70Kg give 60 or 80mg). If coagulation tests are available the aim is to achieve an APTT of 1.5 to 2.5 times the pre-treatment level. If these tests are not available careful monitoring for signs of overdose which can cause haemorrhage should be performed and the pregnant woman or girl warned of the symptoms to look for.
- The pregnant woman or girl can then be discharged home having been taught how to administer the injections and dispose safely of the needles.
- LMWH should be continued for the duration of the pregnancy and at least 3 months after delivery. An expert should be consulted about the use of prophylactic heparin during any further pregnancy.
- On entering labour the pregnant woman or girl should not give any further doses of LMWH until after the delivery of the placenta. If an elective Caesarean section is planned the pregnant woman or girl should have the usual dose of LMWH on the night before surgery

Section 11 Medical emergencies in pregnancy-anaphylaxis, pulmonary embolus but omit the morning dose. After delivery the twice daily dose of enoxaparin should be restarted 4 hours after a vaginal delivery and 8 hours after a Caesarean Section.

Amniotic fluid embolism

This occurs when a bolus of amniotic fluid is released into the maternal circulation during uterine contractions. It becomes trapped in the maternal pulmonary circulation and causes cardio respiratory collapse and clotting problems with disseminated intravascular coagulation (DIC).

Presentation

Amniotic fluid embolism usually presents during the late stages of the first stage of labour. Symptoms include shivering, sweating, anxiety and coughing. Clinical signs are respiratory distress, shock (which may proceed to cardiac arrest) and DIC.

Diagnosis is essentially clinical. Amniotic fluid embolism may occur during labour (70%), during Caesarean section (19%) or immediately post-partum (11%).

Diagnosis of other causes of collapse to consider

- Pulmonary embolism-does not often present in labour; often has chest pain
- Septic shock: raised temperature with symptoms of infection or interference to abort a pregnancy
- Eclampsia- raised blood pressure
- Massive obstetric haemorrhage. Consider a concealed bleed
- Aspiration of gastric contents- usually in an unconscious patient or around the time of a general anaesthetic

Management

Support Airway, Breathing and Circulation. Look for and treat the underlying cause.

THE pregnant woman or girl WITH SHOCK

The pregnant woman or girl who is shocked will be pale, cold and clammy, have a rapid pulse and may be confused or unconscious. Shock may be due to blood loss, a cardiac cause or sepsis. In labour the most likely cause of shock is blood loss, but in the post-partum period the shock may be due to infection acquired before or during labour.

The concept of “**hypotensive resuscitation**” is important if the cause of hypovolaemic shock is haemorrhage. Here the initial boluses of IV crystalloids required to treat shock should only be given to keep the vital organs (especially brain, heart and kidneys) perfused before blood and, of most importance, surgery have become available. Giving too much IV fluids can increase the blood pressure and thus increase bleeding by disrupting early clot formation. IV crystalloid also dilutes the red cells in the circulation but whether or not this could reduce oxygen carrying capacity requires further research.

Our suggestion is that when giving boluses of crystalloid or blood in shock due to bleeding, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs should be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to bleeding. *Adequate perfusion of vital organs* may best be indicated by the following: a radial pulse which can be palpated and a conscious level of A or V on the AVPU scale (i.e. the woman is either awake or will respond by opening her eyes when spoken to).

In haemorrhagic shock, therefore, and to maintain a palpable radial pulse, start with IV boluses of 250-500ml of crystalloid or ideally blood and reassess after each.

Major haemorrhage in first trimester

- Ectopic pregnancy
- Abortion, spontaneous or induced (consider if hypertonic saline or sharp instruments may have been used to procure abortion)
- Molar pregnancy

Major haemorrhage in second or third trimester

1) *Antepartum haemorrhage*

- Placental abruption – placental separation with blood loss concealed or revealed
- Placenta praevia – placenta lies across the cervix
- Vasa praevia – placental blood vessels lying in the membranes and in front of the baby's head.
- Uterine rupture – usually related to a previous Caesarean Section or other operation on the uterus

2) *Postpartum haemorrhage*

- Uterine atony: the commonest cause
- Genital tract injury
- Retained products of conception. This is can be retained pieces, or the entire placenta. This is particularly likely if the placenta is excessively adherent as sometimes happens after a previous Caesarean Section

3) *Coagulation Failure*

This may be due to a pre-existing coagulation problem, or in relation to complications of the pregnancy causing excessive bleeding and consumption of the clotting factors.

Causes include:

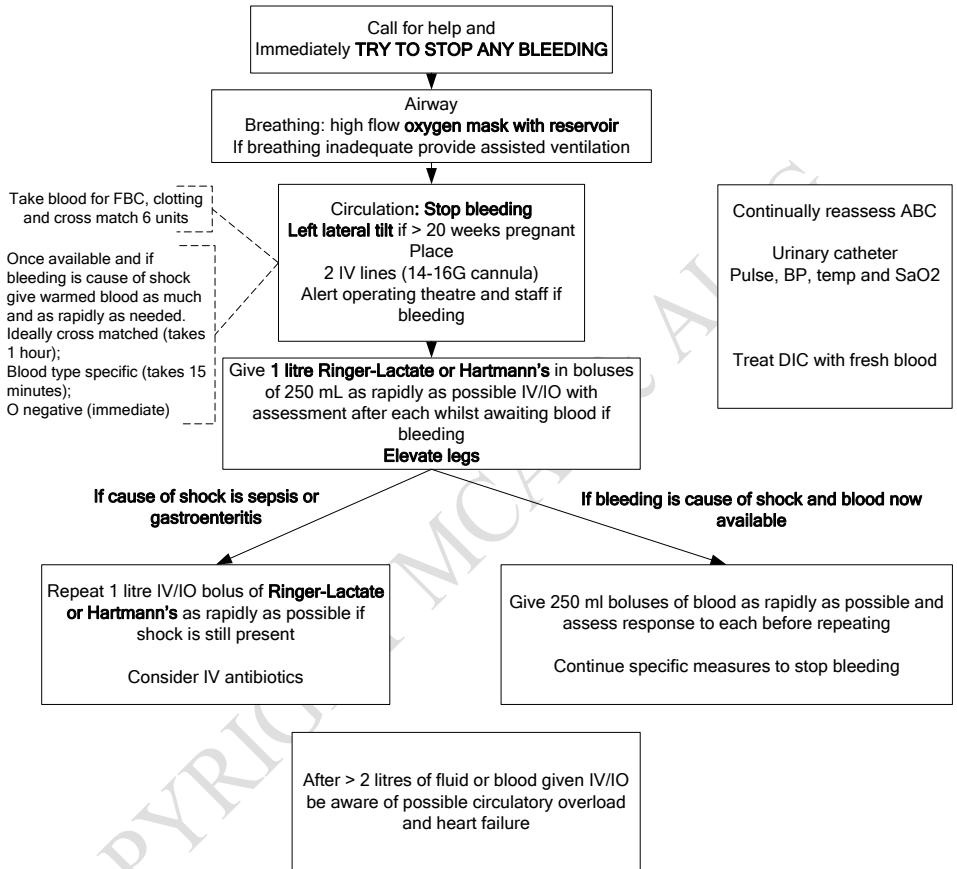
Section 11 Medical emergencies in pregnancy-shock

- Placental separation before delivery
- Pre-eclampsia or eclampsia
- Retained dead fetus
- Septicaemia including intra-uterine sepsis
- Incompatible blood transfusion
- Amniotic fluid embolism

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Section 11 Medical emergencies in pregnancy-shock

Pathway of Care for shock in pregnancy



Major haemorrhage in first trimester

Ruptured Ectopic pregnancy *Must be considered in any girl or woman at any age where pregnancy is possible who presents with acute abdominal pain and shock*

Assessment

Abdominal Pain:	lower abdominal cramping or stabbing pain, shoulder tip pain or rectal pain (free blood)
Vaginal Bleeding	variable – classically irregular and dark in colour
Pregnancy Symptoms	breast tenderness, nausea and tiredness
Abdominal Examination	tenderness with rebound and guarding tip patient head down: may produce shoulder tip pain
Pelvic Examination	tenderness – can be unilateral +/- mass in fornix uterus and cervix softer than when non pregnant uterus smaller than dates from last menstrual period

Diagnosis

Always consider in any girl or woman with abdominal pain of childbearing age

Pregnancy Test Do a pregnancy test in all potentially fertile girls/women.

Ultrasound Positive pregnancy test but no intra-uterine pregnancy.

Free fluid and/or an echogenic mass

Emergency Treatment

Maintain the airway and supplement breathing with high concentration of oxygen through a face mask/reservoir or via a bag-valve-mask as needed.

Circulation

- Gain intravenous access
- Use a short, wide-bore IV cannula if possible (14-16G)
- External jugular vein access is a good option if peripheral access is impossible. Long saphenous vein cut down may also be considered and, if adequately trained, central venous access ideally via internal jugular can be extremely helpful. If vascular access is not possible use an intraosseous needle.
- Try to obtain two vascular access sites to give large volumes quickly and in case one line is lost
- Take blood for cross match of 4-6 units, FBC, renal function tests (if available), blood clotting
- Remember that young, healthy women/girls can lose a lot of blood before becoming shocked, especially if it is a slow leak, rather than a sudden large loss.

The concept of “**hypotensive resuscitation**” is important if the cause of hypovolaemic shock is haemorrhage. Here the initial boluses of IV crystalloids required to treat shock should only be given to keep the vital organs (especially brain, heart and kidneys) perfused before blood and, of most importance, surgery have become available. Giving too much IV fluids can increase the blood pressure and thus increase bleeding by disrupting early clot formation. IV crystalloid also dilutes the red cells in the circulation but whether or not this could reduce oxygen carrying capacity requires further research.

Our suggestion is that when giving boluses of crystalloid or blood in shock due to bleeding, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs should be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to a ruptured and bleeding ectopic

Section 11 Medical emergencies in pregnancy-major haemorrhage-ruptured ectopic pregnancy. *Adequate perfusion of vital organs* may best be indicated by the following: a radial pulse which can be palpated and a conscious level of A or V on the AVPU scale (i.e. the woman is either awake or will respond by opening her eyes when spoken to).

In this situation, therefore, and to maintain a palpable radial pulse, start with IV boluses of 250-500ml of crystalloid or ideally blood and reassess after each.

If diagnosis is ruptured ectopic with heavy bleeding and shock do a Laparotomy whilst resuscitation is underway. Control the bleeding initially to allow the anaesthetist to 'catch up' with the resuscitation before surgical removal of the ectopic and fallopian tube.

Autotransfusion If **blood is unquestionably fresh and free from infection**, blood can be collected after the abdomen is opened and transfused:

When the woman is on the operating table prior to surgery and the abdomen is distended with blood, it is sometimes possible to insert a needle through the abdominal wall and collect the blood in a donor set.

Alternatively, open the abdomen:

- scoop the blood into a basin and strain through gauze to remove clots
- clean the top portion of a blood donor bag (containing anti-coagulant) with antiseptic solution and open it with a sterile blade;
- pour the mother's blood into the bag and infuse it through a filtered set in the usual way;
- if a donor bag with anticoagulant is not available, add sodium citrate 0.3 molar 10 mL to each 90 mL of blood.

Follow up

Counsel not to use intrauterine contraceptives and obtain early ultrasound in next pregnancy.

DIAGNOSIS of abdominal pain in early pregnancy

Symptoms	Clinical Signs	Possible diagnosis
Abdominal pain Light vaginal bleeding	Palpable, tender discrete mass in lower abdomen Adnexal mass on vaginal examination	Ovarian cyst
Lower abdominal pain Anorexia Low-grade fever Nausea/vomiting	Rebound tenderness Paralytic ileus Increased white blood cell count	Appendicitis
Dysuria Retropubic/suprapubic pain Increased frequency and urgency of urination Abdominal pain		Cystitis
Dysuria Retropubic/suprapubic pain Spiking fever/chills Increased frequency and urgency of urination Abdominal pain Anorexia, nausea/vomiting	Loin tenderness	Acute pyelonephritis
Fever/rigors Lower abdominal pain Anorexia Nausea/vomiting	Rebound tenderness Rigid abdomen Abdominal distension Absent bowel sounds Shock	Peritonitis
Abdominal pain Fainting Light vaginal bleeding Amenorrhea Shoulder tip pain	Closed cervix Tender adnexal mass Uterus slightly larger than normal Uterus and cervix softer than normal	Ectopic pregnancy

Acute appendicitis

Give a combination of antibiotics before surgery and continue postoperatively until fever-free for 48 hours (ampicillin 2 g IV 6 hourly plus gentamicin 5 mg/kg body weight IV 24 hourly plus metronidazole 500 mg IV 8 hourly).

Perform an immediate surgical exploration (regardless of stage of gestation). In pregnancy the site of the incision should be placed over the point of maximum tenderness.

Abortion (miscarriage)

Consider abortion in any woman of reproductive age who has a missed period and has one or more of the following: bleeding, cramping, partial expulsion of products of conception, dilated cervix or smaller uterus than expected. The important differential diagnosis to exclude is an ectopic pregnancy.

If **abortion is a possible diagnosis** identify and treat any complications immediately (remove any herbs, local medications or caustic substances in cases of suspected unsafe abortion).

Management

THREATENED ABORTION =conservative. May settle or progress to one of the following
COMPLETE ABORTION =conservative unless associated with complications, see below
INEVITABLE ABORTION =allow to abort, but treat any complications. If **incomplete** proceed as below.

INCOMPLETE ABORTION

If bleeding is light to moderate and pregnancy < 16 weeks: use fingers or ring (or sponge) forceps to remove products of conception protruding through the cervix.

If bleeding is heavy and pregnancy < 16 weeks,

-evacuate the uterus using manual vacuum aspiration (sharp curettage should only be done if vacuum is unavailable)

- If **evacuation is not immediately possible:** give ergometrine 500 micrograms IM (repeated after 15 minutes if necessary) OR misoprostol 400 micrograms orally (repeated once after 4 hours if necessary).

If pregnancy >16 weeks:

- Infuse oxytocin 40 units in 1 Litre Hartmanns at 40 drops per minute until expulsion of products of conception occurs.

- If necessary give misoprostol 200 micrograms vaginally every 4 hours until expulsion, but do not administer more than 800 micrograms in total.

- Evacuate any remaining products of conception from the uterus manually.

Emergency Treatment if shocked

Maintain the airway and supplement breathing with high concentration of **oxygen** through a face mask/reservoir or via a bag-valve-mask as needed.

Circulation

- Gain IV access with 2 wide-bore IV cannula (if possible 16-18G)
- Take blood for FBC, cross matching (4 units) and whole blood clotting time
- Give IV fluids and blood as needed to resuscitate (remember that young, healthy women can lose a lot of blood before becoming shocked, especially if the leak is slow as opposed to a sudden large loss)
- Start with a rapid fluid bolus of 1 litre IV of Ringer-Lactate or Hartmann's

If severe septic shock is possible give IV antibiotics in high doses immediately: Ampicillin (2 g IV loading dose then 1 gram 6 hourly) plus gentamicin (5 mg/kg body weight IV 24 hourly, WHO 80mg IM 8 hourly) plus metronidazole (500 mg IV 8 hourly).

Diagnosis and management of complications of abortion (miscarriage)

<ul style="list-style-type: none"> • Lower abdominal pain rebound tenderness • Tender uterus • Prolonged bleed • Malaise / Fever • Purulent discharge • Cervical excitation 	Infection/sepsis	Begin antibiotics ^a as soon as possible before attempting manual or vacuum aspiration.
<ul style="list-style-type: none"> • Abdominal cramps • Rebound tenderness • Abdominal distension • Rigid abdomen • Shoulder pain • Nausea/vomiting • Fever 	Uterine, vaginal or bowel injuries	Perform a Laparotomy to repair the injury and perform manual vacuum aspiration simultaneously. Seek further assistance if required.
<p>^a Give for example ampicillin 2 g loading dose the 1 gram IV 6 hourly PLUS gentamicin 5 mg/kg body weight IV 24 hourly (or WHO 80mg IM 8 hourly) PLUS metronidazole 500 mg IV 8 hourly until the pregnant woman or girl is fever-free for 48 hrs.</p>		

Major haemorrhage in second or third trimester

1) Antepartum haemorrhage

- Placental abruption – placental separation with blood loss concealed or revealed
- Placenta praevia – placenta lies across the cervix
- Vasa praevia – placental blood vessels lying in the membranes and in front of the baby's head.
- Uterine rupture – usually related to a previous Caesarean Section or other operation on the uterus

2) Postpartum haemorrhage

- Uterine atony: The commonest cause
- Genital tract injury
- Retained products of conception. This is can be retained pieces, or the entire placenta. This is particularly likely if the placenta is excessively adherent as sometimes happens after a previous Caesarean Section

3) Coagulation Failure

This may be due to a pre-existing coagulation problem, or in relation to complications of the pregnancy causing excessive bleeding and consumption of the clotting factors.

Causes include:

- Placental separation before delivery
- Pre-eclampsia or eclampsia
- Retained dead fetus
- Septicaemia including intra-uterine sepsis
- Incompatible blood transfusion
- Amniotic fluid embolism

Management of major haemorrhage in the second or third trimester

Call for the most senior help available

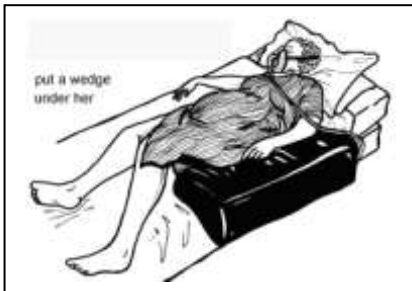
Think about possible causes when taking a history and assessing the patient.

Recognise signs of hypovolaemia

- Tachycardia
- Cold, pale, sweaty and possibly cyanosed skin
- Alteration of mental state: confusion or unconscious
- Fall in urine output
- Narrowed pulse pressure
- Hypotension (late sign)

Restore circulating volume

- Position the pregnant woman or girl in the left lateral position to minimise the effects of aorto-caval compression. A wedge may be used during obstetric procedures. Assistants can also manually displace the uterus.



- Administer high concentration oxygen (10-15 L per minute) with close fitting face mask and reservoir regardless of her oxygenation assessment.
- Assess the airway and respiratory effort. Intubation (if safe and available) may be necessary to protect the airway if the woman has depressed consciousness or to maximise the oxygenation. Otherwise place in the recovery position.
- Establish two IV lines using the largest available cannula. Lower limb and femoral vessels should be avoided.
- Take blood for Hb, whole blood clotting time and cross match blood (minimum 4 units).
- Expand the circulation

The concept of "**hypotensive resuscitation**" is important if the cause of hypovolaemic shock is haemorrhage. Here the initial boluses of IV crystalloids required to treat shock should only be given to keep the vital organs (especially brain, heart and kidneys) perfused before blood and, of most importance, other medical and surgical measures have become available. Giving too much IV fluids can increase the blood pressure and thus increase bleeding by disrupting early clot formation. IV crystalloid also dilutes the red cells in the circulation but whether or not this could reduce oxygen carrying capacity requires further research.

Section 11 Medical emergencies in pregnancy-major haemorrhage-later pregnancy

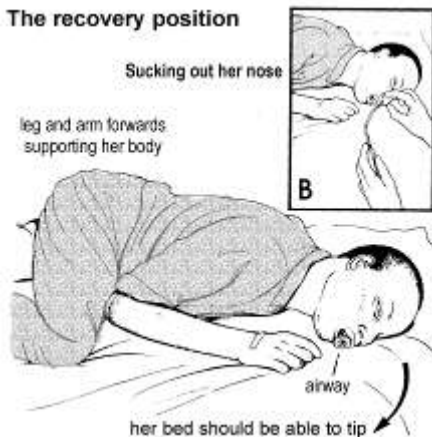
Our suggestion is that when giving boluses of crystalloid or blood in shock due to bleeding, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs should be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to massive haemorrhage in pregnancy. *Adequate perfusion of vital organs* may best be indicated by the following: a radial pulse which can be palpated and a conscious level of A or V on the AVPU scale (i.e. the woman is either awake or will respond by opening her eyes when spoken to).

- In this situation, therefore, and to maintain a palpable radial pulse, start with IV boluses of 250-500ml of crystalloid or ideally blood and reassess after each.
- O Rh negative blood can be used in life-threatening haemorrhage but ideally ABO and Rhesus compatible blood should be used

When stable move to a place where there is adequate space, light and equipment to continue resuscitation and treatment.



The recovery position



Blood transfusion

If time allows full cross match should be undertaken. If the pregnant woman or girl's blood group is known and she needs blood very urgently type specific blood can be given. In the life-threatening situation O Rhesus Negative blood may be used.

One unit (500 ml) of whole blood will raise the haemoglobin by 1 g/dl. Concentrated red cells have a volume of 300 ml (220 ml of red cells and 80 ml of saline-adenine- glucose-mannitol solution).

Frequent checks of the haematocrit are helpful to guide massive transfusions, particularly when adequate measure of loss is impossible. Stored blood has a reduction in platelet

Section 11 Medical emergencies in pregnancy-major haemorrhage-later pregnancy numbers and important clotting factors so if a massive transfusion is required the administration of clotting factors and platelets will be required. If not give blood which is as fresh as possible.

Any large volume of IV fluids or blood should be carefully warmed before use, ideally by a dry electrical warmer. Traditional water baths carry the risk of electrical hazards. If no warmer is available an assistant can warm each bag against their body. Keeping the patient warm is also essential.

If large volumes of blood are needed urgently, inflate a blood pressure cuff around the bag of IV fluid to increase rate of infusion. Alternatively use 3 way tap, 20 or 50 ml syringes and rapid manual infusion.

Evaluation of response

Essential monitoring includes pulse, BP, respiration rate, SaO₂ and fluid balance. Regular checks of the haematocrit and whole blood clotting time are important.

ANTEPARTUM HAEMORRHAGE

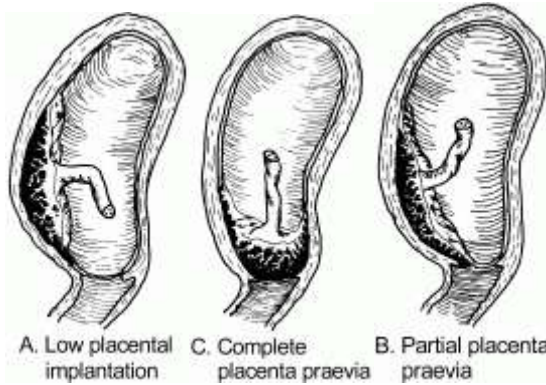
Placental abruption (separation)

Bleeding may be concealed or revealed. Findings include continuous abdominal pain, uterine tenderness and a woody, hard uterus. The baby is often dead. If not, urgent Caesarean Section, if safe and available, should be performed. If the baby is dead, early attempts to induce labour will help to reduce further maternal bleeding. Coagulation problems may occur after a fetus has been dead for > 4 weeks. Failure of uterine contraction after delivery increases the risk of a large post-partum haemorrhage.

Placenta Praevia

Major bleeding usually occurs in the last month of pregnancy, but there is often history of smaller bleeds previously. The bleeding is painless and without obvious cause. Diagnosis is best made by abdominal ultrasound scan. Certain clinical signs suggest placenta praevia, for example an oblique lie or a soft uterus not suggestive of an abruption. If ultrasound is not possible then Caesarean section should be performed.

There is an increased risk of placenta praevia and accreta (abnormal placental adherence) in pregnant women or girls who have had a previous Caesarean Section.

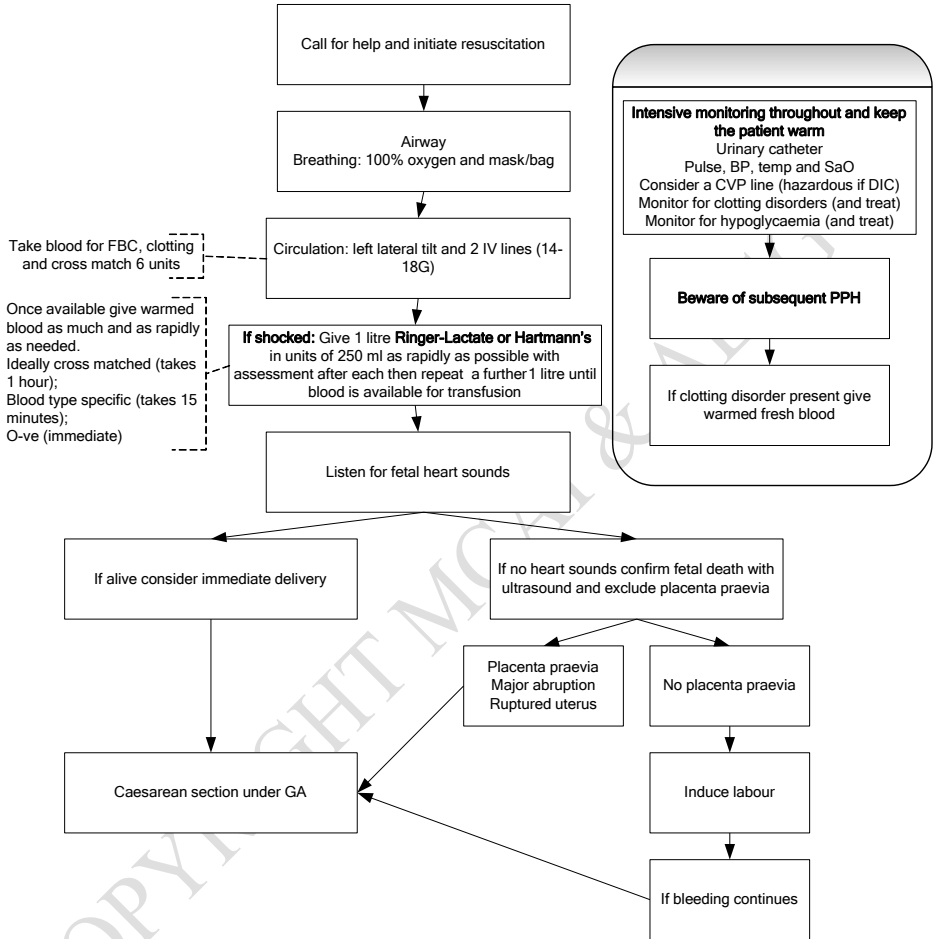


Clinical features of a large ante-partum haemorrhage (APH)

Pallor, tachycardia, shock, pain (may be absent), vaginal bleeding (may be concealed).

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Pathway of care massive APH



IT IS THE APH BY REMOVING CLOTTING FACTORS FROM THE CIRCULATION THAT WEAKENS AND THEN THE PPH THAT KILLS ATTENTION SHOULD CONSTANTLY FOCUS ON RESUSCITATION TO MAINTAIN THE CIRCULATION

Ruptured uterus

This presents with hypovolaemic shock, but vaginal bleeding can be concealed. The baby is usually dead

A previous Caesarean Section scar may rupture during labour but obstructed labour even without a uterine scar, particularly in a woman of high parity, may cause uterine rupture. Excessive doses of oxytocin during labour, particularly if there is cephalo-pelvic disproportion, can precipitate this. Rupture of the uterus can also occur following violence or trauma.

Symptoms and signs

- Change in nature of pain in labour from severe intermittent to constant
- PV bleeding may or may not be present (a haemoperitoneum from a ruptured uterus can fail to drain vaginally due to an impacted fetal head and care should be taken to gently dislodge the head a little to look for signs of bleeding)
- Maternal shock, plus dehydration, exhaustion, acidosis if prolonged obstructed labour.
- Abdominal palpation is tender, fetal parts easily palpated, absent fetal heart
- On VE the presenting part may be high or impacted: the fetal head may have retreated into the uterus

Differential diagnosis is placental abruption.

Emergency Management

1. Suspect – in any patient with risk factors such as previous CS
2. Emergency treatment of

Airway and Breathing oxygen by mask/reservoir and with self inflating bag if inadequate breathing

Circulation – 2 wide bore IV cannulas (14 – 18 g)

Blood sent for FBC and crossmatch

IV fluids to replace volume-500-1000ml

Ringer-Lactate or Hartmann's initially as rapidly as possible

3. Call obstetrician (if available)
4. Obtain consent
5. Perform urgent laparotomy under anaesthesia
6. Give IV prophylactic antibiotics (ampicillin 2g or cefuroxime 1.5g plus metronidazole 500mg)

Post partum haemorrhage

Indicated by vaginal bleeding. Other signs may include pallor, tachycardia, shock, and bradycardia

Causes

Heavy bleeding after delivery can arise from

- atonic uterus
- trauma to the genital tract
- retained products of conception

In these situations the bleeding is revealed, **although the uterus can fill with blood before any becomes apparent vaginally**. Ruptured uterus can cause concealed bleeding as can bleeding following CS.

Tachycardia is the first sign of shock, but if a woman is pale and bradycardic do a vaginal examination to remove clot from cervix or reveal uterine inversion.

IM syntometrine (5 units oxytocin plus 500 micrograms of ergometrine) or oxytocin (5 or 10 units IM) with delivery of the anterior shoulder of the fetus is recommended to aid the separation of the placenta by enhancing uterine contractions and reducing the risk of bleeding from an atonic (relaxed) uterus. **It is essential that you are certain before such drugs are given that there is not another baby**. If the placenta has not delivered within 30 minutes of delivery of the baby, further management will be required.

Delayed severe secondary PPH is usually caused by retained products of conception which undergo necrosis, become infected and prevent involution of the uterus.

A fever suggests an infectious cause, and purpura suggests Disseminated Intravascular Coagulation = DIC

Management of large PPH

Call for help

Airway

- Use an opening maneuver, if not patent, or partially obstructed. If there is improvement, use airway adjuncts to support the airway.
- Suction as required

Breathing

- Provide 100% oxygen through a face mask with reservoir bag if adequate spontaneous respiration
- For inadequate ventilation or depressed conscious level (AVPU), give chest inflations with a bag-valve-mask and 100% O₂ and summon anaesthetist (if available)

Circulation

- Assess pulse rate and volume, Capillary refill time, BP and urine output

STOP FURTHER BLEEDING using procedures below at same time as gaining IV or if not possible IO access

- Insert wide-bore IV cannulae x 2 (14G-18G) and send blood for FBC, cross-match (4 units) and clotting
- Give 1 litre Ringer-Lactate or Hartmann's if shocked
- Give an additional 1 litre bolus IV of Ringer-Lactate or Hartmann's or plasma expander until blood arrives
- Give O negative or group specific blood if no time for cross-match
- Give fresh blood as soon as possible

Uterine atony

Poor contraction of the uterus after delivery is the commonest cause of post-partum haemorrhage.

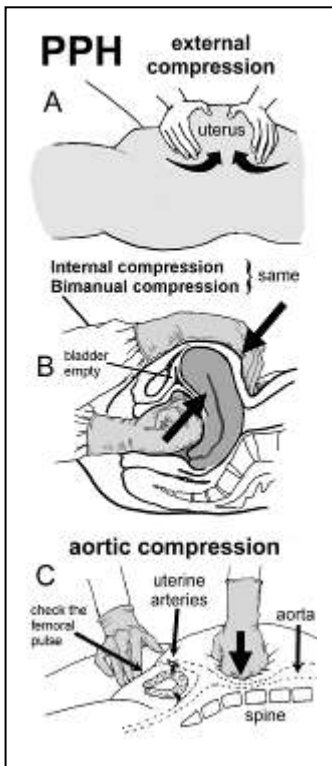
Drugs to make the uterus contract

A repeat dose of 10 iu oxytocin IM/IV and repeat again after 20 minutes. If the pregnant woman or girl does not have eclampsia, pre-eclampsia or hypertension, ergometrine 0.2mg IM will help uterine contraction.

Supplement the above bolus drugs with an IV infusion of oxytocin 40 u in 500ml 0.9% saline or Ringer Lactate over 4 hours.

(WHO recommended dose: 20 u in 1 litre of 0.9% saline or Ringer Lactate at a rate of 180ml/hour (60 drops/minute) for 4 hours then 10 u in 1 litre of 0.9% saline or Ringer lactate at 90ml/hour (30 drops/minute).)

If this fails misoprostol is an excellent alternative which unlike oxytocin does not need to be kept in a refrigerator. It is given sublingually as 4 of 200 microgram tablets or rectally as 4 to 5 of 200 microgram pessaries.



Abdominal massage of the uterus

If the uterus does not contract a contraction may be rubbed up by abdominal massage.

Massage fundus in a circular motion with cupped palm of the hands until contracted

When well contracted, place fingers behind fundus and push down in one swift action to expel clots

Bimanual uterine compression

If heavy PPH continues despite uterine massage and oxytocin/ergometrine/misoprostol treatment and the placenta is not in place apply bimanual uterine compression.

Must wear sterile gloves

Introduce right hand into vagina, clench fist with back of hand posteriorly and knuckles in the anterior fornix

Place other hand on abdomen behind the uterus and squeeze the uterus firmly between both hands

Continue compression until bleeding stops (no bleeding when compression released)

Aortic compression

If bleeding still persists apply aortic compression:

Feel femoral pulse

Apply pressure above umbilicus to stop bleeding with sufficient pressure that femoral pulse cannot be felt

- After finding correct site show an assistant how to apply the pressure
- Continue until bleeding stops. If bleeding continues continue pressure whilst transferring the mother to hospital.

Exclude trauma to cervix or vagina

Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion

If the bleeding continues, examine to exclude trauma to the vagina or cervix for retained products of conception or a ruptured uterus.

Uterine packing

Uterine packing with sterile ribbon gauze or better a hydrostatic balloon such as a Rusch balloon or condom over a foley catheter can help to control haemorrhage.



Retained placenta

Definition: After active management of the third stage and the placenta is not delivered within 30 minutes of birth.

After expectant management of the third stage and the placenta is not delivered within 60 minutes of the birth.

Risk factors include a full bladder, a previous retained placenta, high parity, uterine fibroid, history of previous uterine surgery and placenta praevia. It may become trapped in the cervix or lower uterus. There may be no bleeding with a retained placenta, especially if there is abnormal adherence (placenta accreta).

It occurs in around 2% of deliveries.

Management

If there is a clinically significant post partum haemorrhage (PPH), the placenta must be removed urgently. Call for help including anaesthetist and obstetrician, insert a venous cannula, and take blood for Hb and cross match as for PPH above and ensure operating theatre is ready.

Massage the uterus and, if there is atony, manage as for PPH above. However, although oxytocin should be used as necessary, do not give ergometrine because it causes tonic uterine contraction, which may delay expulsion.

Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion

Cause 1. The placenta is separated but trapped in the lower part of the uterus or cervix. If the placenta is undelivered after 30 minutes of oxytocin stimulation, and the uterus is contracted and the placenta separated (usually indicated by the gushing of blood and rising of the uterus into the abdomen as a firm, more movable structure as with a normal placental separation and delivery), attempt controlled cord traction. During this, and at all times, a hand is present on the abdomen supporting the uterus and preventing it from inversion.

Note: Avoid forceful cord traction and fundal pressure, as they may cause uterine inversion.

This situation usually responds to firm and persistent traction on the cord with the other hand countering this on the uterus to prevent inversion. Ensure that the bladder is empty. Catheterise the bladder, if necessary. If you can see the placenta, ask the mother to push it out; an upright position may help. Undertake a sterile vaginal examination and if you can feel the placenta in the vagina or cervix, remove it.

Cause 2. The placenta has failed to separate from the uterus. If controlled cord traction is unsuccessful, attempt umbilical vein injection of utero-tonic drugs or, if this fails, manual removal of placenta (see below).

Umbilical vein injection of a utero-tonic drug

Dilute 10-100 iu oxytocin (usually 50 iu) in 20 mL of 0.9% saline in a syringe. Also draw up another 10 mL of 0.9% saline in a separate syringe. Open onto a sterile towel a scalpel blade and a size 8-10 gauge infant feeding tube or a large IV cannula (14 gauge).

Clamp the umbilical cord with an additional artery forceps, 10-20cm from the vulva. The umbilical vein will be obvious as a large dilated vein full of blue blood. Swab the cord with antiseptic solution.

If using the infant feeding cannula, make an opening in the vein around 1cm towards the vulva from the artery forceps and then insert the cannula into the vein and pass it into the placenta as far as it can go (do not force it) and then draw back around 1 cm. Then compress the cord around the opening in the cord by the cannula to prevent leakage and inject the 50 iu of oxytocin through the cannula into the placenta and follow it with the 10 mL of 0.9% saline. Then move the artery forceps to clamp the cord over the cannula to stop backflow.

If using the venous cannula, insert this directly into the vein, remove the needle leaving the cannula in the vein and inject as above. Similarly compress the cord around the plastic cannula whilst injecting and afterwards clamp over the cannula with the artery forceps.

If this is successful, the placenta will separate as indicated by a gush of blood and a rising of the uterus into the abdomen becoming firm and movable. Remove the placenta by controlled cord traction.

As an alternative to 50 iu of oxytocin, misoprostol can be used (800 microgram (usually 4 of 200 microgram tablets) dissolved in 20 ml 0.9% saline injected as above).

If this fails proceed immediately to manual removal of placenta (see below)

Cause 3. The placenta is morbidly attached to the uterus

Very adherent tissue may be placenta accreta. Efforts to extract a placenta that does not separate easily may result in heavy bleeding or uterine perforation which usually requires hysterectomy. Rarely, in such cases the placenta can be left in-situ and should separate

Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion and expel itself over time. In these cases the mother must be observed carefully for signs of infection, given prophylactic antibiotics and warned about what to expect when the placenta is eventually expelled.

If bleeding continues, assess clotting status using a bedside clotting test. Failure of a clot to form after 7 minutes or a soft clot that breaks down easily, suggests coagulopathy. If there are signs of infection (fever with foul-smelling vaginal discharge), give antibiotics as for endometritis.

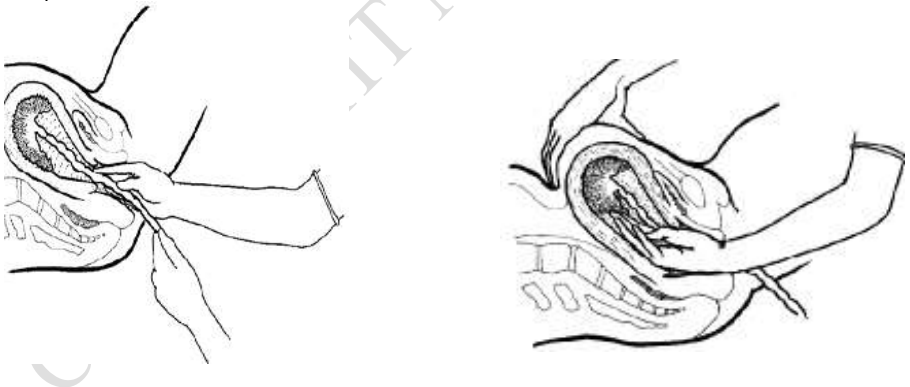
Manual removal of placenta

This is a painful procedure with a high risk for infection unless undertaken using full sterile procedures. Unless undertaken as an emergency for major PPH, we consider it should be undertaken in an operating theatre under spinal anaesthesia. Elbow-length sterile gloves should be used. Provided active PPH is not occurring, the mother should first be adequately resuscitated with IV fluids/blood and oxygen. There should be close monitoring of pulse rate, blood pressure, oxygen saturation and urine output.

After removal of the placenta, massage the uterus to encourage tonic uterine contraction. An IV infusion of oxytocin 40 units in 500 mL of Ringer-Lactate or Hartmann's should be administered over 4 hours to ensure continued uterine contraction.

After manual removal give ampicillin 2g IM/IV

If fever > 38.5C, foul smelling lochia or history of ruptured membranes for 18 or more hours add gentamicin 80mg IM/IV to the ampicillin. Continue antibiotics IM/IV until 48 hours after end of fever and then give oral amoxicillin 500mg tds until 7 days of treatment has been completed.

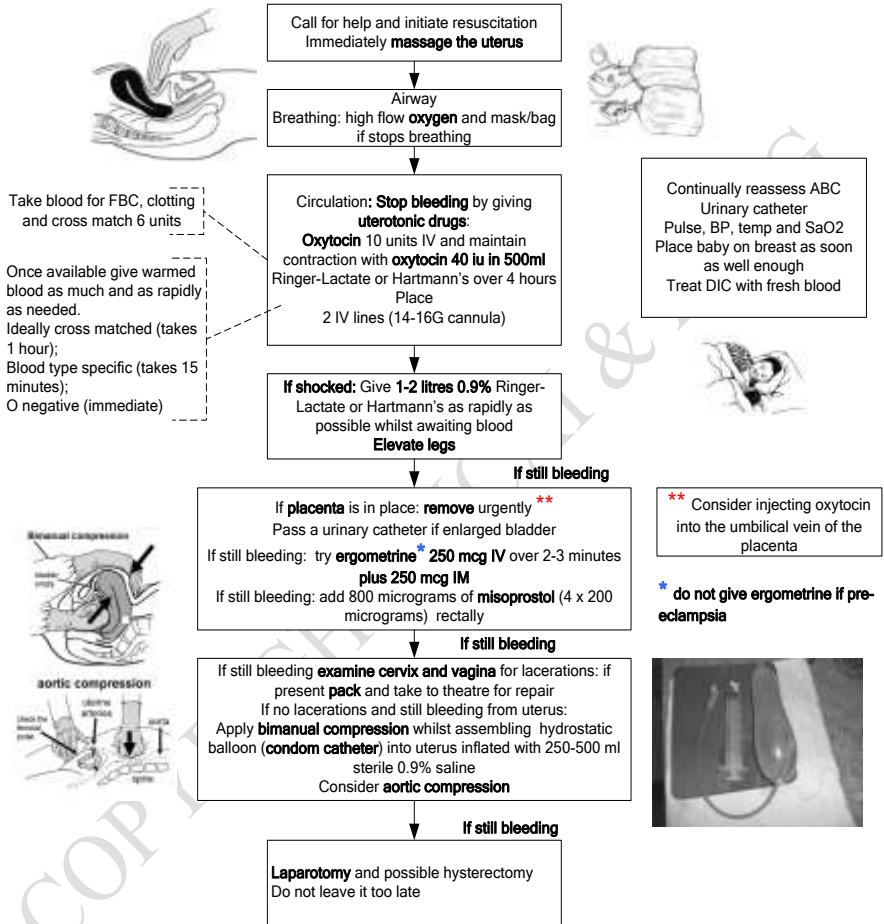


Introducing one hand into the vagina along the cord and then supporting the fundus while detaching the placenta

Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion

Large postpartum haemorrhage: Pathway of Care

AIM FOR A CONTRACTED AND EMPTY UTERUS



Check Hb or haematocrit after resuscitation and consider iron orally if anaemic

Uterine inversion

Definition

In this condition the uterus, after or during delivery of the placenta, is inverted and can appear at the introitus

Prevention

Prevent by avoiding cord traction until there are signs of placental separation

Clinical signs

Early recognition is vital.

Associated with haemorrhage in >90% of cases.

Shock is most common complication (40%). Shock out of proportion to blood loss may be due to increased vagal tone.

Most commonly presents as a pelvic mass, sometimes protruding from the vagina. Where it does not protrude from the vagina, it may go undetected resulting in a sub-acute or chronic inversion or even unexplained maternal death.

Symptoms and signs include severe lower abdominal pain in the third stage of labour, haemorrhage, shock out of proportion to blood loss, uterus not palpable on abdominal examination and vaginal examination showing a mass in the vagina.

A bradycardia may be present due to increased vagal tone.

Concealed intra-abdominal bleeding producing tachycardia and shock may be present.

Incomplete inversions present more subtly with continuing PPH despite a contracted uterus; the fundus of the uterus may feel dimpled.

Suspect diagnosis

- If shock with little obvious bleeding
- If continuing PPH despite apparently well contracted uterus
- If associated lower abdominal pain
- If dimpled uterine fundus or fundus not palpable abdominally

Management

Urgent to replace as it becomes more fixed over time

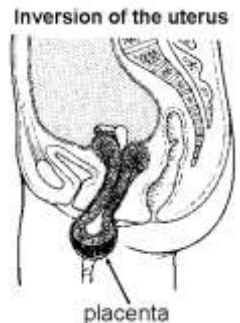
Call for senior help: If available

Emergency treatment

Airway

- Use an opening maneuver, if not patent, or partially obstructed. If there is improvement, use airway adjuncts to support the airway.
- Suction as required
- The airway may need to be secured by intubation using experienced senior help (if available)

Breathing



Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion

- Provide high concentration of oxygen through a face mask with reservoir bag for adequate spontaneous respiration
- For inadequate ventilation or depressed conscious level (AVPU), give chest inflations with a bag-valve-mask and 100% O₂ and summon experienced senior help (if available)
- **Circulation**
- Assess pulse rate and volume, Capillary refill time, BP and urine output
- Insert wide-bore IV cannulae x 2 (14G-18G) and send blood for FBC, cross-match and clotting
- Give 1 litre Ringer-Lactate or Hartmann's IV as rapidly as possible if shocked
- Give atropine 0.6mg IV if heart rate <60/minute.

Manual replacement

As soon as possible attempt manual replacement of the uterus by pushing the fundus back through the cervix (the longer the delay the more difficult)

Grasp the uterus and push it through the cervix towards the umbilicus to its normal position, using the other hand to support the uterus. If the placenta is still attached, perform manual removal after correction.

It is important that the part of the uterus that came out last (the part closest to the cervix) goes in first.

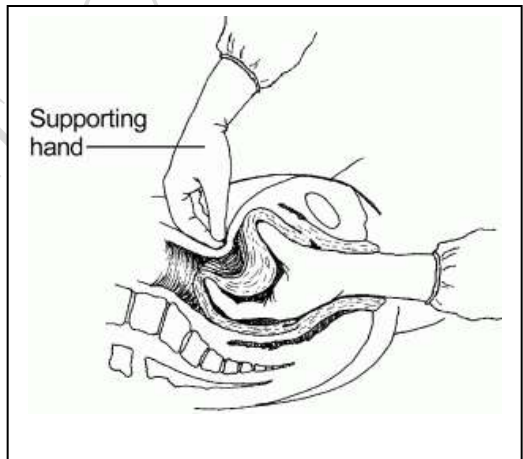
Placental Delivery

Do not attempt to separate the placenta until inversion corrected

Hydrostatic correction

Place the woman in deep Trendelenburg position (lower her head about 0.5 metres below the level of the perineum). Prepare a high-level sterile douche system with large nozzle and long tubing (2 metres) and a warm reservoir (1 to 2 litres of sterile 0.9% saline or Ringer-Lactate or Hartmann's). **Note:** This can also be done using an ordinary IV administration set.

Identify the posterior fornix. This is easily done in partial inversion when the inverted uterus is still in the vagina. In other cases, the posterior fornix is recognized by where the rugose vagina becomes the smooth vagina.



Place the nozzle of the douche in the posterior fornix.

At the same time, with the other hand hold the labia sealed over the nozzle and use the forearm to support the nozzle.

Section 11 Medical emergencies in pregnancy-major haemorrhage-uterine inversion

Ask an assistant to start the douche with full pressure (raise the water reservoir to at least 2 metres). 0.9% saline will distend the posterior fornix of the vagina gradually so that it stretches. This causes the circumference of the orifice to increase, relieves cervical constriction and results in correction of the inversion.

If a silc-cup ventouse is available this can be used to occlude the vagina and give a seal. Two IV infusion sets are inserted into the narrow end whilst the wide end lies against the inverted uterus vaginally.

If above unsuccessful, replace the uterus under general anaesthesia as above or via Laparotomy

Drugs such as Magnesium sulfate 2-4 grams infused IV over five minutes may be helpful to relax the cervical ring and help replacement.

Manual correction under general anaesthesia

If **hydrostatic correction is not successful**, try manual repositioning under general anaesthesia using halothane. Halothane is recommended because it relaxes the uterus.

Grasp the inverted uterus and push it through the cervix in the direction of the umbilicus to its normal anatomic position. If the **placenta is still attached**, perform a manual removal after correction.

Post procedure care

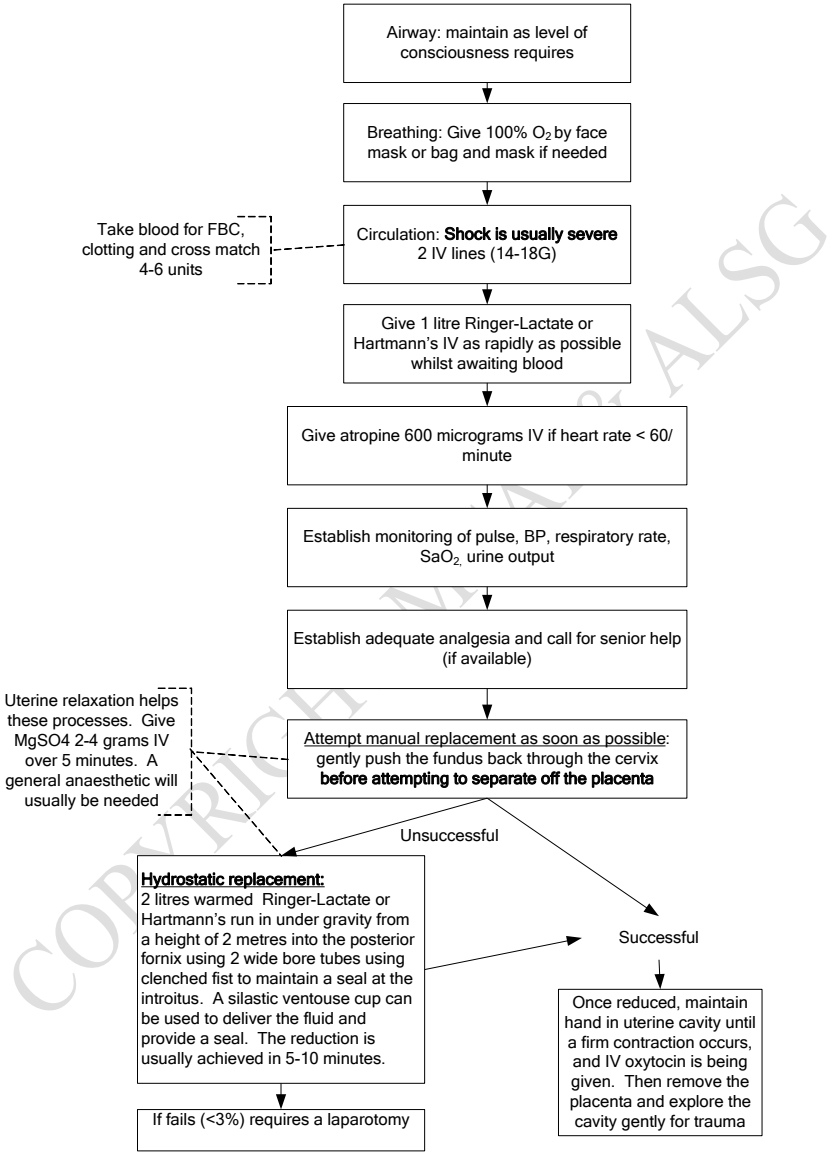
Once the inversion is corrected, infuse IV oxytocin 40 units in 500 ml normal saline or Ringer's lactate over 4 hours:

- If the **uterus does not contract after oxytocin**, give misoprostol 4 of 200 microgram pessaries rectally.

Give a single dose of prophylactic antibiotics after correcting the inverted uterus. - ampicillin 2 g IV PLUS metronidazole 500 mg IV

Give appropriate analgesic drugs.

Pathway of Care Uterine Inversion



Septic causes of shock

Sepsis is a common cause of maternal death and long term morbidity.

Important causes of sepsis in obstetric patients

- Infection of the uterus and birth canal after septic abortion or birth of the baby: postpartum endometritis (puerperal sepsis)
- Acute gastroenteritis
- Pneumonia
- Meningitis
- Malaria
- Pyelonephritis
- Wound infection
- Acute appendicitis with peritonitis

Clinical signs of sepsis

- tachypnoea
- tachycardia
- fever
- altered mental state
- shock

Some septic patients may not have a fever. Infection after delivery can be slow in onset and progress rapidly. Treatment of underlying infection must be linked to monitoring and supporting failing organ functions. Appropriate monitoring in the early stages of sepsis includes temperature, pulse, respiratory rate, blood pressure, SaO₂ and hourly urine output. Early investigations include full blood count, whole blood clotting time, urine microscopy, urea and electrolytes, liver function tests and blood cultures.

Management of sepsis

Airway and Breathing

Maintenance of adequate oxygenation is an important step in the resuscitation of patients with sepsis. Many patients who develop shock will ideally require intensive care including intubation and ventilation because of the development of adult respiratory distress syndrome.

Circulation

Almost all patients with septic shock have hypovolaemia and IV fluid resuscitation is a mainstay of treatment. Patients who remain hypotensive despite adequate fluid resuscitation will require more intensive fluid management with central venous pressure monitoring and inotropes.

Prevention of infection

Prophylactic antibiotics should be seriously considered following invasive procedures such as Caesarean Section, manual removal of placenta and during the delivery of a pregnant woman or girl with a valvular heart disease. Septic abortion is a major cause of mortality and antibiotic cover should be considered for instrumental uterine evacuation.

Section 11 Medical emergencies in pregnancy-gastroenteritis

The pregnant woman or girl **with severe acute gastroenteritis**

- Is a common cause of dehydration and shock
- Assess fluid deficit (extent of dehydration) and measure ongoing losses of fluid
- Weigh
- Keep accurate fluid balance chart
- Important to give fluids which:
 - Correct deficit
 - Provide maintenance
 - Replace ongoing losses

Differential Diagnosis

Look for abdominal mass or abdominal distension.

Remember

- HIV infections
- surgical conditions such as acute appendicitis, peritonitis, bowel obstruction (if suspected resuscitate and call for surgical opinion)
- typhoid (high grade fever, rash, hepato-splenomegaly, toxicity)
- antibiotic associated colitis
- rarely, inflammatory bowel disease

Treatment if not shocked

- Start ORAL REHYDRATION SOLUTION (ORS) with 1 to 2 litres over 2-4 hours
- Carer gives small amounts of ORS fluid (eg small cup)
- Gradually increase the amount as tolerated using tablespoon, cup or glass
- REASSESS HYDRATION after 2-4 hours, then progress to the maintenance phase or continue re-hydration

Severe dehydration (> or =10% fluid deficit +/-shock)

- If shocked, start IV re-hydration immediately (2 intravenous lines if possible, or long saphenous vein cut down or intra-osseous needle)
- Give 1 litre bolus of Ringer-Lactate or Hartmann's as rapidly as possible IV
- Reassess pulse, perfusion (capillary refill) and mental status and repeat bolus if still abnormal
- DO NOT EVER USE low sodium containing IV fluids such as 0.18% saline with 4% glucose which can be DANGEROUS if given quickly (hyponatraemia and cerebral oedema). Instead use Ringer-Lactate or Hartmann's, ideally also containing 10% glucose (obtained by adding 100ml of 50% glucose to each 500ml)

When shock has resolved and the patients level of consciousness returns to normal, the remaining estimated deficit MUST BE TAKEN by mouth or by gastric tube especially if severe malnutrition and/or anaemia (danger of large IV fluid volume IV)

Assess hydration status frequently

Oral Fluids

Recommendations for oral replacement therapy in gastroenteritis are:

- use either low-sodium ORS (containing 40-60 mmol/L of sodium), or
- if unavailable, use ORS containing 75-90 mmol/L of sodium with an additional source of low-sodium fluid (eg water)
- Dose = 300-500ml/hour
- giving high osmolar fluids may contribute to hypernatraemia, whilst giving water alone, or low salt drinks may cause hyponatraemia
- oral glucose within ORS enhances electrolyte and water uptake in the gut
- home made ORS can be made by adding a pinch of salt (1ml) and a handful of sugar (5ml) to a glass of clean water (250ml)

Section 11 Medical emergencies in pregnancy-gastroenteritis

Intravenous Fluids

- even in patients who are drinking poorly, try to give enteral fluids by mouth or by gastric tube until the IV drip is running
- use Ringer's Lactate or Hartmann's Solution which has Na 131mmol/l; K 5mmol/l; HCO₃ 29mmol/l; Ca 2mmol/l
- Hartmann's solution has no glucose to prevent hypoglycaemia: this can be corrected by adding 100ml of 50% glucose to 500ml of Hartmann's giving approximately a 10% glucose solution (adding 50ml gives a 5% solution)
- Ringer's Lactate Solution already prepared with 5% dextrose has the added advantage of providing glucose to help prevent hypoglycaemia.
- If Ringer's Lactate or Hartmann's is unavailable, use 0.9% saline. It does not contain a base to correct acidosis and does not replace potassium losses, therefore add 5mmol/litre of Potassium Chloride. Also it does not contain glucose and therefore add 100ml of 50% glucose to 500ml of 0.9% saline to give approximately a 10% glucose solution (adding 50ml of 50% glucose gives a 5% solution).

Do NOT use plain 5% glucose solutions, or 0.18% saline + 4% glucose. They do not contain adequate electrolytes, do not correct the acidosis or hypovolaemia and can produce dangerous hyponatraemia

- all patients should start to receive some ORS solution (about 300ml per hour) when they can drink without difficulty, which is usually within 1 - 2 hours. This provides additional base and potassium, which may not be adequately supplied by the IV fluid. Alternatively give as soon as possible by gastric tube.

Over-hydration

- oedematous (puffy) eyelids may be a sign of over hydration, cardiac failure (as in severe malnutrition), chronic malnutrition or protein losing enteropathy
- cardiac failure (especially in severe malnutrition or severe anaemia), chronic malnutrition or protein losing enteropathy
- A CXR may be helpful in showing pulmonary plethora or oedema
- stop giving ORS solution, but give plain water and food
- do not give a diuretic

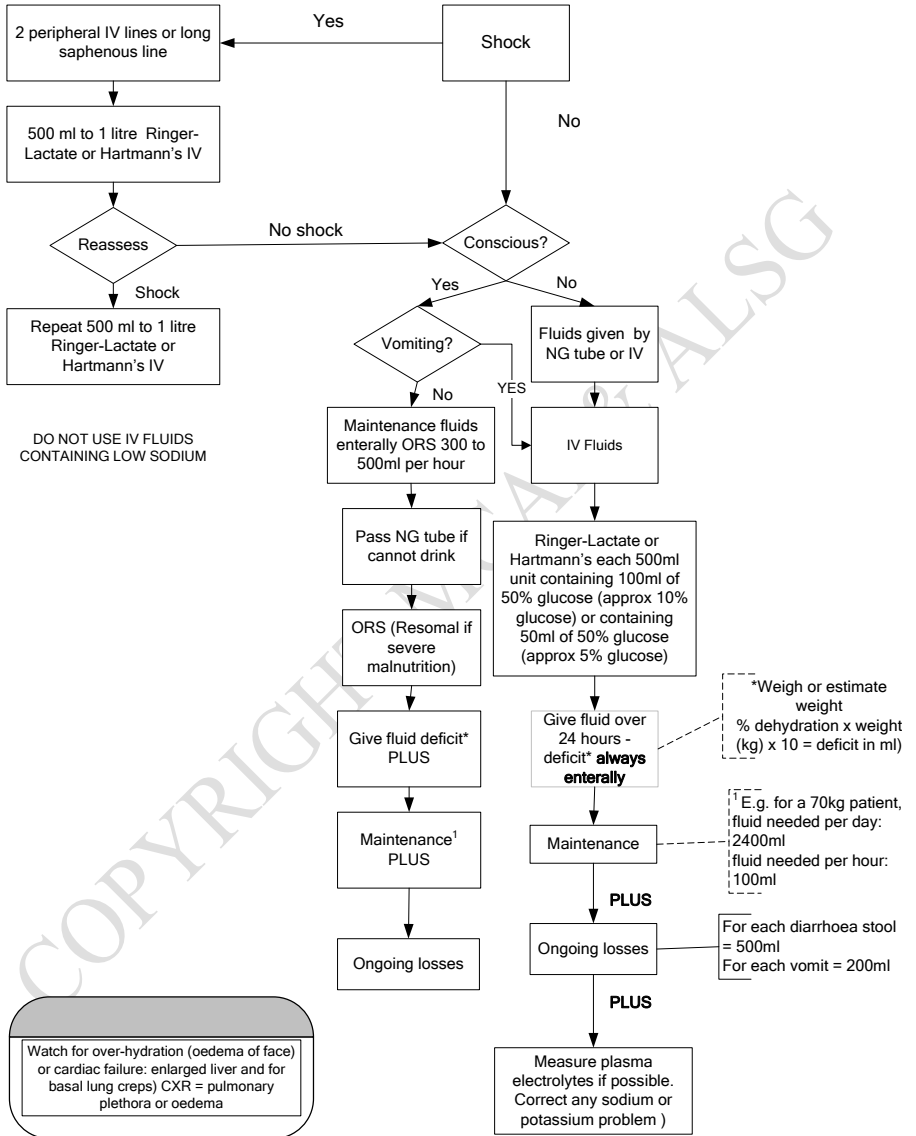
When the oedema has gone, resume giving ORS solution

Reassess

- ABC
- state of intravascular repletion
- plasma electrolytes if possible
- urine output and urine electrolytes
- give fluid according to plan, don't forget ongoing losses
- reassess regularly (including biochemistry if possible)

Don't forget glucose

Pathway of care for severe dehydration (10% or more) in pregnancy

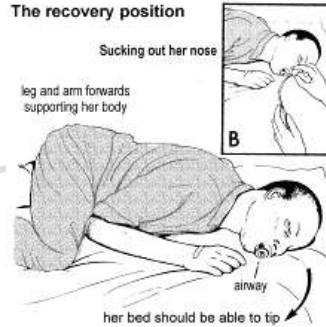


THE CONFUSED, FITTING OR UNCONSCIOUS pregnant woman or girl

Primary assessment and resuscitation

a) Airway

The patient with a reduced level of consciousness is more likely to have a compromised airway as the tongue falls into the back of the mouth. There is also a risk of aspiration. Assess the airway and maintain its patency. Apply oxygen at 15 litres per minute via a tight fitting face mask with a reservoir bag. If an anaesthetist is present intubation can be performed to protect the airway, otherwise adopt the recovery position. Careful suction of the nose and/or mouth maybe helpful.



b) Breathing

Assess the breathing, give high flow O₂ via face mask and reservoir bag if necessary. Assist ventilation.

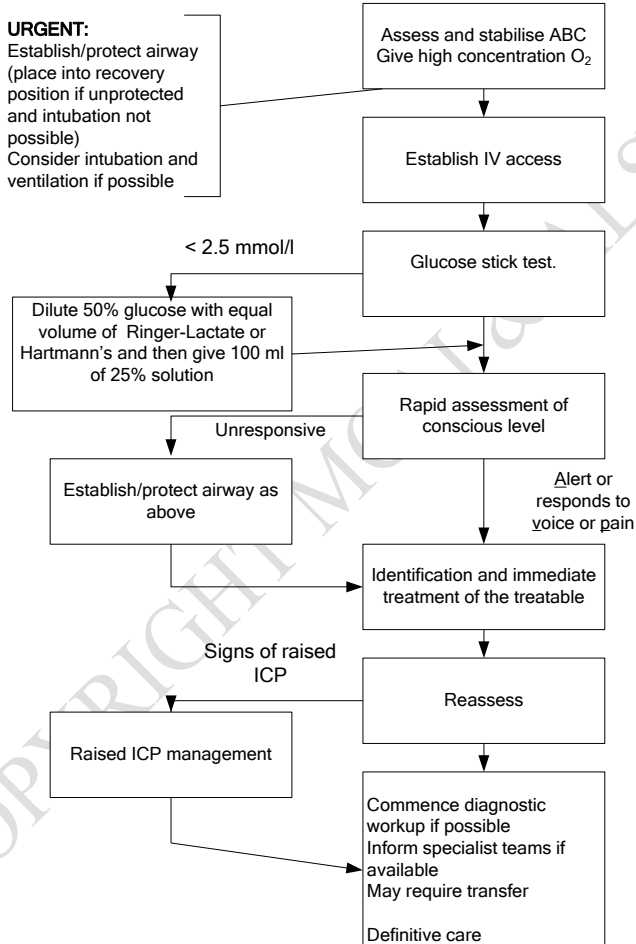
c) Circulation

Inadequate perfusion of blood to the brain initially produces confusion and later coma. Measurement of the blood pressure in addition to other markers for shock is crucial in recognising hypovolaemia after haemorrhage or unconsciousness after an eclamptic fit with hypertension. IV access should be achieved and blood sent for blood count, blood smear for malarial parasites, electrolytes, liver function tests, blood glucose, and blood culture.

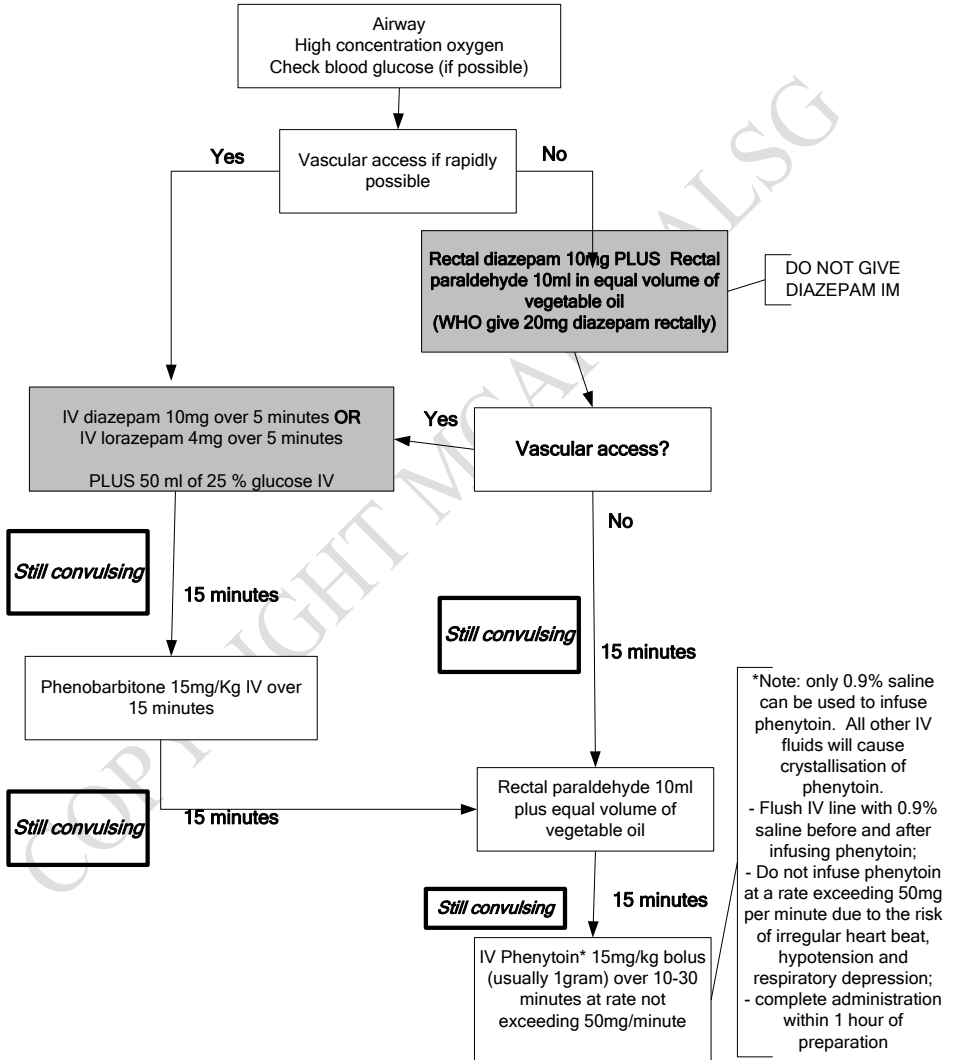
d) Disability (neurological)

If the blood sugar is low give 50 ml of 25% glucose IV and then add 100ml of 50% glucose to each 500ml of Ringer-Lactate or Hartmann's infused (this makes a solution of 10% dextrose in Ringer-Lactate or Hartmann's). In pregnancy to make 25% glucose add 50ml of 50% glucose to 50ml of Ringer-Lactate or Hartmann's.

Pathway of care in coma in a pregnant woman or girl



Pathway of Care status epilepticus in pregnancy (not due to eclampsia)



When the patient is stable, consider the following causes of confusion, coma or fits.

- 1 Eclampsia
- 2 Trauma
- 3 Cerebral malaria
- 4 Meningitis
- 5 Pre-existing epilepsy
- 6 Sub-arachnoid haemorrhage
- 7 Cerebral thrombosis
- 8 Hypoglycaemia (usually in the pregnant woman or girl on insulin especially early pregnancy)
- 9 Drug intoxication
- 10 Anaesthetic complications eg total spinal block.

Convulsions

If there are fits, has the pregnant woman or girl having eclampsia? Test the urine for protein and measure her blood pressure.

If she is not suffering from eclampsia, prevent her having more fits with a loading dose and subsequent maintenance doses of phenytoin.

PHENYTOIN

Loading dose

Infuse phenytoin 1 g (approximately 18 mg/kg body weight) in 50–100 ml 0.9% saline over 30 minutes (final concentration not to exceed 10 mg per ml):

Note: Only 0.9% saline can be used to infuse phenytoin. All other IV fluids will cause crystallization

Flush IV line with 0.9% saline before and after infusing phenytoin.

Do not infuse phenytoin at a rate exceeding 50 mg per minute due to the risk of arrhythmias, hypotension and respiratory depression.

Complete administration within 1 hour of preparation.

Maintenance dose

Give phenytoin 100 mg IV slowly over 2 minutes or by mouth every 8 hours beginning at least 12 hours after the loading dose.

Pre-eclampsia and eclampsia

This is pregnancy-induced hypertension (BP 140/90 or greater) in association with proteinuria (usually > 0.5 gram per 24 hours). It is a multi-system rather than a primary hypertensive disorder. Eclampsia is fitting associated with the syndrome of pre-eclampsia, but seizures can occur without any previous signs or symptoms. Severe hypertension (diastolic blood pressure exceeding 110 mm of mercury) increases the risk of eclampsia and control of blood pressure is an important part of the management. HELLP is a syndrome comprising haemolysis, elevated liver enzymes and low platelets. It commonly occurs in eclamptic patients, sometimes without significant hypertension.

Maternal complications:

- eclampsia
- risk of cerebro-vascular accident
- renal failure
- liver failure
- disseminated intra-vascular coagulation
- pulmonary oedema
- pulmonary haemorrhage

Section 11 Medical emergencies in pregnancy-pre-eclampsia and eclampsia

- placental abruption

Important clinical signs include:

- headache
- visual disturbances
- epigastric pain
- vomiting
- generalised oedema
- pulmonary oedema
- right upper quadrant abdominal tenderness
- hyper-reflexia with clonus

Management of severe pre-eclampsia

Consider admission if blood pressure exceeds 140/90 mm Hg, with significant proteinuria or if there are symptoms as described above. Full assessment of the patient includes regular measurement of blood pressure, reflexes and fluid balance with tests for urinary protein and urine output, fetal heart rate monitoring and ultrasound.

Investigations

- full blood count (ideally with platelet count)
- urea and electrolytes
- liver function tests (if available)
- coagulation screen (whole blood clotting time)
- urine for protein

Blood Pressure Control

Hypertension should be treated if it exceeds a systolic pressure of >170 mmHg or diastolic BP >110mmHG or MAP >125mmHg

Aim to reduce BP to around 130-140/90-100mmHg

Careful fetal monitoring during commencement of treatment is vital as a rapid fall in maternal blood pressure may cause fetal heart rate abnormalities, especially in a growth-restricted or compromised fetus. Intravenous hydralazine or labetalol may be used to lower the blood pressure. As hydralazine may cause increased maternal heart rate, labetalol is preferable if the maternal pulse exceeds 120 beats per minute. If the gestation is less than 36 weeks, betamethasone 12 mg IM in 2 doses 24 hours apart should be given to improve fetal lung maturity and prevent neonatal respiratory failure.

Hydralazine

This is the anti-hypertensive drug of choice. Give 5 mg IV slowly over 5 minutes (it acts within 5 minutes), then 5 mg IV every 15 minutes until diastolic BP is 90-100mmHg. Repeat hourly as needed, or give hydralazine 12.5mg IM every 2 hours as needed.

Alternatively, give hydralazine IV infusion, 20 mg in 200 mL 5% dextrose at 0.5 mL (10 drops) per minute (20 drops = 1mL for a standard giving set), and stop the drip when diastolic BP is 90 mm Hg or less. Hydralazine may cause increased maternal heart rate.

Side effects are flushing, tachycardia, palpitations, headache and, uncommonly, a lupus syndrome.

Section 11 Medical emergencies in pregnancy-pre-eclampsia and eclampsia

Labetolol

Intravenous labetolol is preferable to hydralazine if the maternal pulse rate exceeds 120 beats per minute.

Labetolol dosage is 10 mg IV. If response is inadequate (diastolic blood pressure remains above 110 mm Hg) after 10 minutes, give a further dose of labetolol 20 mg IV. Increase the dose to 40 mg and then 80 mg if satisfactory response is not obtained after 10 minutes of each dose.

Alternatively use an IV infusion of 200 mg in 200 mL Ringer Lactate at 40 mg/hour, increasing dose at half-hourly intervals as required to a maximum of 160 mg/hour.

Side effects are bradycardia, bronchospasm, weakness, scalp tingling (only for 24-48 hours), nausea and headache. Labetolol is contra-indicated in asthma, as it may cause severe bronchospasm.

Nifedipine

Nifedipine is a calcium antagonist which may be administered as an initial 10mg oral dose (onset of action within 10-20 minutes) with a repeat of 10 mg if inadequate response after 30 minutes. Subsequent oral doses are 20 mg bd. Side effects are severe headaches associated with flushing and tachycardia. Oedema, weakness and constipation may occur. It is contraindicated in aortic stenosis. It may inhibit labour. It may interact with magnesium sulphate, and give profound hypotension and/or heart block.

Give prophylactic magnesium sulphate if severe hypertension is accompanied by at least 2 + of proteinuria and/or symptoms suggesting that eclampsia may occur (see below).

Fluid balance

Pregnant woman or girls with pre-eclampsia and eclampsia are effectively hypovolaemic. However, they have hypoalbuminaemia and are easily fluid overloaded. Accurate fluid balance charts are essential. Measurement of central venous pressure may aid fluid management, but if unavailable a fluid infusion of the same quantity as the urinary output in each preceding hour plus 30 ml is safe. The need for in-utero transfer should be considered, particularly if there are maternal complications likely to require high dependency care. The need for delivery is dependent on the maternal and fetal condition. Either Caesarean section or induction of labour may be appropriate, depending on the clinical findings. Although delivery will resolve the disease, it is inappropriate to deliver an unstable pregnant woman or girl, even if there is fetal distress. Once eclamptic seizures are controlled, severe hypertension treated and hypoxia corrected, delivery can be expedited.

Management of imminent eclampsia or eclampsia (*see pathway of care for eclampsia*)

General measures

- do not leave the patient alone
- call for help
- prevent maternal injury during convulsion
- place in a semi-prone position

Airway and Breathing

- assess, maintain and protect airway
- apply oxygen mask with reservoir: give oxygen 12 - 15 litres per minute
- assess breathing
- assist ventilation as required

Circulation

- Evaluate pulse and blood pressure.
 - if absent initiate CPR
 - left lateral tilt and manually displace uterus from vena cava
 - secure IV access
 - monitor blood pressure
 - attach pulse oximeter
 - insert urinary catheter with strict fluid input/output chart

Medication for the management of seizures:

Magnesium sulfate treatment

The majority of seizures are self-limiting and do not require diazepam which increases the risk of respiratory arrest. Magnesium sulfate is the anti-convulsant of choice.

Loading dose in well resourced settings

4g of magnesium sulfate = 20ml of 20% solution (to make 20ml of a 20% solution = add 8ml of 50% MgSO₄ solution to 12 ml sterile water) IV in 200ml of 5% dextrose solution over 20 minutes. If there is a recurrence of convulsions (after completion of the loading regime) give 2g (10ml of 20% solution) magnesium sulfate in 100ml 5% dextrose IV slowly over 20 minutes.

Loading dose in poorly resourced settings

5g (10ml of 50% solution=5g in 10ml) by deep intramuscular injection in each buttock (plus 1ml of 2% lidocaine in same syringe). Thus total dose given = 10 grams.

ASEPTIC TECHNIQUE ESSENTIAL

Maintenance dosage

- **Well resourced:** Provided there is close monitoring (ideally with a burette in giving set), give 1g/hour IV in normal saline every 4 hours for 24 hours.
- **Poorly resourced:** 5g IM 4 hourly (plus 1ml of 1% lidocaine (WHO 1ml of 2%) in same syringe) using alternate buttocks. Continue for 24 hours after the last convulsion or delivery.
Continue for 24 hours after delivery or after last convulsion provided that:

- respiratory rate is > 16 per minute
 - urine output > 30 ml per hour (WHO >100ml over 4 hours)
 - patella reflexes present
- Remember to subtract volume infused from total maintenance infusion volume to avoid fluid overload

When using magnesium sulfate, monitor hourly urine output, respiratory rate, SaO₂ and patellar reflexes every 10 minutes for the first 2 hours and then every 30 minutes

Side effects

If mother is conscious always warn her that there will be a feeling of warmth passing through her body when MgSO₄ is infused and that this is not harmful. Failure to do so may result in the mother pulling out her IV cannula and other potentially dangerous reactions. Other side effects are nausea, vomiting, absent tendon reflexes, diplopia, somnolence/slurred speech, respiratory depression and arrest, hypotension and arrhythmias.

Keep total (IV + oral) fluids at a rate less than 100ml per hour.

Contra-indications to magnesium sulfate

DO NOT GIVE, OR STOP INFUSION OF, MAGNESIUM SULFATE IF

1. Patellar reflexes are absent
2. There is respiratory depression (respiratory rate less than 15/min)
3. Urine output is less than 30ml/hour over last 4 hours

If respiratory depression develops: give 100% oxygen by face mask with reservoir and give Calcium gluconate 1g (10ml of 10% solution) IV slowly over 10 minutes

If respiratory arrest occurs:

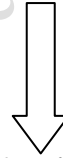
1. Prompt chest inflations with bag mask ventilation with 100% oxygen
2. Injection calcium gluconate 1g (10ml of 10%) IV slowly over 10 minutes

The magnesium sulfate infusion may be recommenced at a reduced dose if thought necessary once normal respiration and reflexes have returned.

Note: There is an increased sensitivity to muscle relaxants (particularly non-depolarising agents) in patients on magnesium.

Progressive symptoms of magnesium toxicity:

1. feeling of warmth, flushing, double vision, slurred speech
2. loss of tendon reflexes
3. respiratory depression
4. respiratory arrest
5. cardiac arrest



If magnesium toxicity is suspected, stop infusion and administer antidote of 10 ml 10% calcium gluconate IV over 10 minutes.

OBSERVATIONS

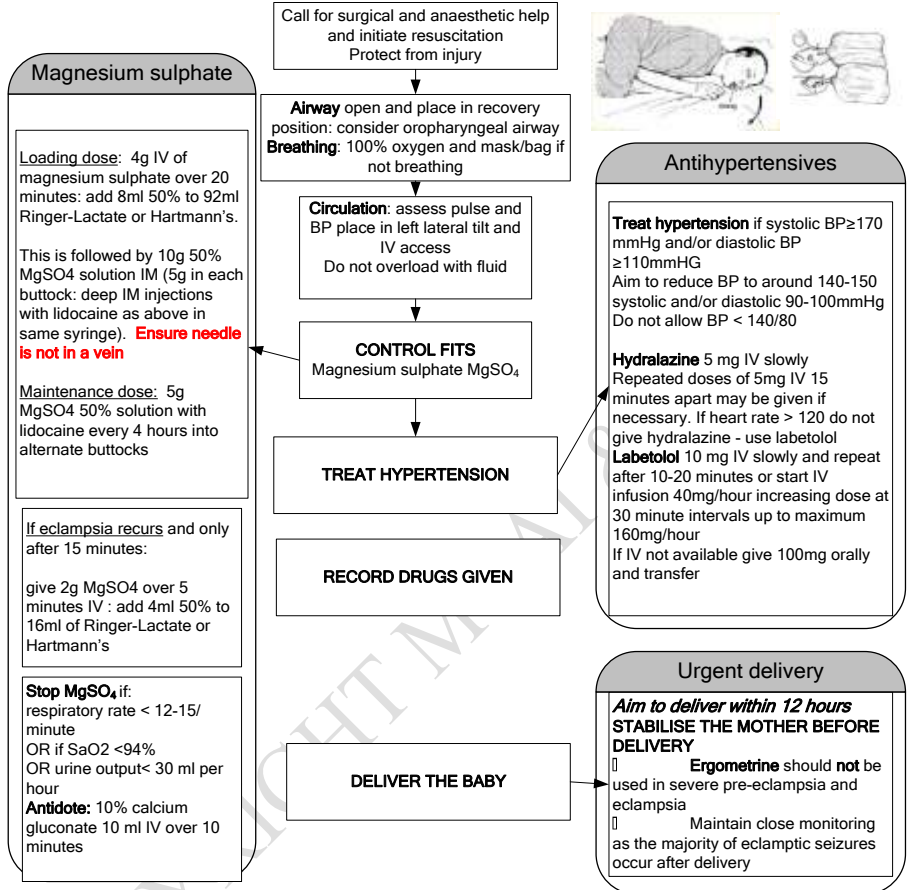
Pulse oximeter BP
Respirations
Listen to lungs for basal creps
Temperature
Test urine for protein
Hourly urine output
Fluid balance charts
FHR – monitor continuously

INVESTIGATIONS

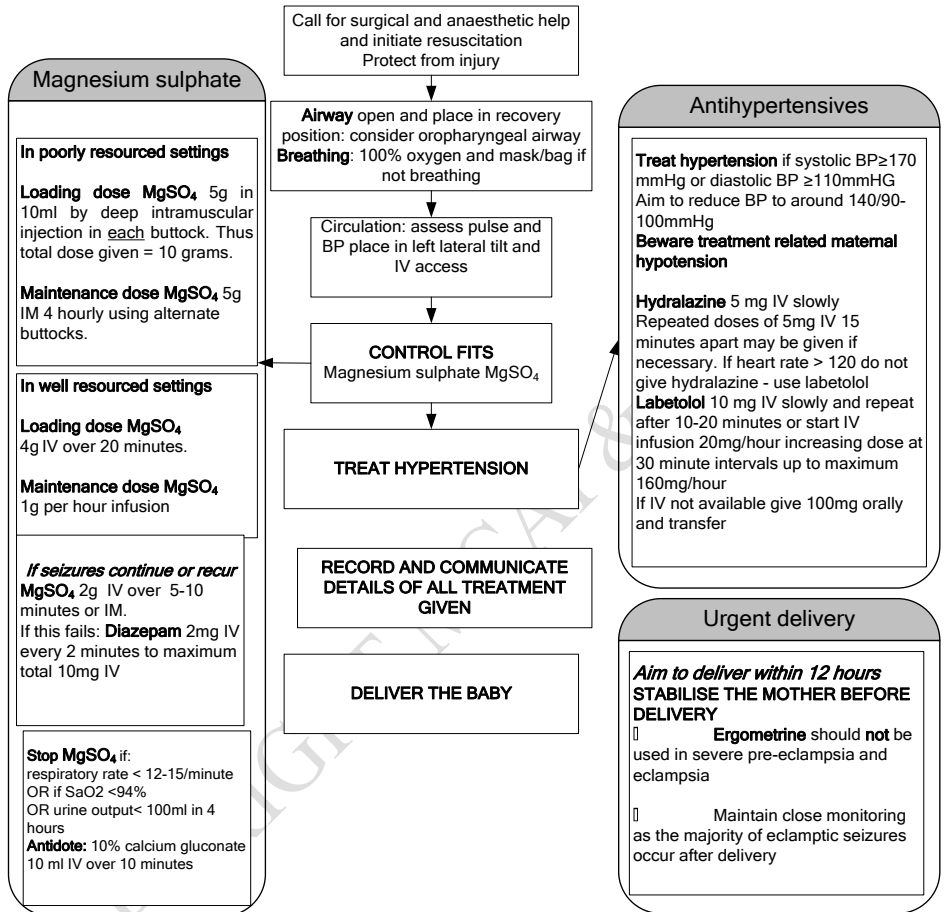
Hb, cross match, whole
blood clotting time
Regular urine protein
checks

Section 11 Medical emergencies in pregnancy-pre-eclampsia and eclampsia

Pathway of care in eclampsia (Liberia regime)



Section 11 Medical emergencies in pregnancy-pre-eclampsia and eclampsia
Pathway of care in eclampsia (MCAI/ALSG regime)



Section 11 Medical emergencies in pregnancy-meningitis and malaria

Meningitis

Signs and symptoms:

- Headache
- Vomiting
- Neck stiffness
- Opisthotonus
- Photophobia
- Rash
- Altered consciousness

A lumbar puncture may be dangerous in the presence of raised intracranial pressure. High dose IV antibiotics according to local protocols will be needed for at least 10 days.

Severe complicated malaria, usually falciparum

This results in fever, extreme weakness, headaches, vomiting, jaundice, drowsiness, convulsions and coma. Malaria in pregnancy may be misdiagnosed as eclampsia; always measure the BP and look for protein in the urine.

Pregnant women or girls with severe malaria are particularly prone to hypoglycaemia, pulmonary oedema, anaemia, convulsions and coma.

Malaria is especially dangerous during the last trimester.

Drug treatment

IV artesunate

This is the first line treatment

LOADING DOSE

Give artesunate 2.4 mg/kg IV as a single bolus slowly over 5 minutes on the first day of treatment.

MAINTENANCE DOSE : At 12 and 24 hours, give a maintenance dose of 1.2 mg/kg IV over 3 minutes. Then give artesunate 1.2 mg/kg daily until conscious and able to swallow. When able to swallow give artesunate 2 mg/kg by mouth once daily to complete 7 days of treatment.

IM Artemether

This is the second choice for treatment

LOADING DOSE: Artemether IM 3.2 mg/Kg

MAINTENANCE DOSE: Artemether IM 1.6mg/Kg once daily for 3 days

Quinine dihydrochloride

This is only given if artesunate or artemether is not available

LOADING DOSE : Infuse quinine dihydrochloride, 20 mg/kg body weight (usually 1.2 grams for the average 60 kg pregnant woman) (max 1.4g) in 1 litre of IV fluids (5% or 10% dextrose or Ringer-Lactate or Hartmann's plus 5 or 10% glucose) over 4 hours. Do not allow the infusion to go in too quickly **by using a burette within an IV giving set.** Quinine is usually available in 2 ml ampoules of either 150 mg/ml where 1.2 g is thus 8 ml OR 300mg/ml where 1.2 g is thus 4ml.

Never give an IV bolus injection of quinine

If it is definitely known that the pregnant woman or girl has taken an adequate dose of quinine (1.2 g) within the preceding 12 hours, do **not** give the loading dose. Proceed with the maintenance dose only (see below).

If the **history of treatment is not known or is unclear**, give the loading dose of quinine; Always wait 4 hours before giving the maintenance dose.

Section 11 Medical emergencies in pregnancy-meningitis and malaria



MAINTENANCE DOSE

Infuse quinine dihydrochloride 10 mg/kg body weight (usually 600mg) (max 700mg) in 1 litre of 5 or 10% glucose in Ringer-Lactate or Hartmann's IV over 4 hours. Repeat every 8 hours (i.e. quinine infusion for 4 hours, no quinine for 4 hours, quinine infusion for 4 hours, etc.).

Note: Monitor blood glucose levels for hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) every hour while the pregnant woman or girl is receiving quinine IV.

Continue the maintenance dosing schedule until the pregnant woman or girl is conscious and able to swallow and then give: quinine dihydrochloride or quinine sulfate 10 mg/kg body weight (usually 600mg) by mouth every 8 hours to complete 7 days of treatment. Ask the pregnant woman or girl to swallow tablets quickly with milk.

Alternatively, in areas where sulfadoxine/pyrimethamine is effective, give sulfadoxine/pyrimethamine-Fansidar 3 tablets as a single dose.

Caution!

- Watch for hypoglycaemia (**less than 2.5 mmol/litre (45mg/dl)**): always give IV quinine in a 5-10% glucose solution as described above.
- Make sure plenty of fluids are given so that the urine output is adequate. Keep a strict fluid balance chart and do not overload with fluid.

If the Hb falls below 6 g/dl give a blood transfusion with 40mg IV frusemide immediately before the blood starts. When the pregnant woman or girl is improving give iron and folate tablets.

Intramuscular quinine.

This is given at strength of not more than 60 mg/ml. Some ampoules are 60 mg/ml (usually 10 ml ampoules). Some ampoules are 300 mg/ml or 600 mg/ml. Dilute these in 0.9% saline to a concentration of 60 mg/ml. (For example 600 mg of quinine in 10 ml of saline). If you don't dilute quinine, the pregnant woman or girl may get an injection abscess. Use the same dose as you would give IV. Give half the dose into each anterior thigh. (WHO does not recommend dilution)

Caution!

- When giving quinine by IM injection, regularly draw back to ensure the needle is not in a vein.
- If you know that the pregnant woman or girl has had an adequate dose of quinine in the previous 12 – 24 hours, don't give a loading dose. If you don't know what quinine treatment she has had, if any, give a loading dose.

COMPLICATIONS OF SEVERE MALARIA

Life threatening anaemia

Monitor Hb levels daily.

Transfuse as necessary. If the Hb is 5 g/dl or less or there is pulmonary oedema, transfusion is urgent.

Monitor fluid balance very carefully.

Give frusemide 40mg IV with each unit of blood.

Give iron 120 mg by mouth plus folic acid 5mg (WHO 400 micrograms) by mouth daily upon discharge for 3 months.

Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl))

This can occur on admission or after quinine. Often it causes no symptoms until it results in coma and death. Watch for abnormal behavior, sweating, and sudden coma. Always give glucose with quinine. If drowsy, delirious or unconscious, don't assume the pregnant woman or girl has cerebral malaria: she is probably hypoglycaemic. Check blood glucose every hour if possible, especially if on quinine.

Treat suspected hypoglycaemia with IV 50 ml of 25% glucose, **OR** 250 ml of 10% glucose. 50% glucose is very irritant to veins and harmful if extravasated, so dilute it with 0.9% saline or Ringer-Lactate or Hartmann's to make a 25% solution. Subsequently give 250ml of 10% glucose over 8 hours.

If you don't have IV glucose, give sugar water by mouth or by nasogastric tube. Dissolve 4 level teaspoons (20 g) in 200 ml of clean water.

Fluid imbalance

Maintain a strict fluid balance chart and monitor the amount of fluids administered and urine output to ensure that there is no fluid overload. Assess clinical status regularly.

If urine output is poor (< 30 ml per hour): Re-hydrate with IV fluids (Ringer-Lactate or Hartmann's).

If urine output does not improve, give frusemide 40 mg IV as a single dose and monitor urine output.

Pulmonary oedema

The pregnant woman or girl may have it on admission, or it may come on after several days. Fast difficult breathing is the first sign. Frothy (bubbly) fluid may be coming from the mouth. It causes hypoxia, fits, coma and death. It can also be caused by too much IV fluid. Sometimes it is caused by malaria and too much IV fluid, so monitor the central (JVP) venous pressure regularly.

- Keep upright, so prop up with pillows in the left lateral tilt position and lower the foot of the bed.
- Give high concentrations of oxygen using face mask and reservoir.
- Give frusemide 40 mg IV. If there is no response (no increase in urine output) increase the dose progressively, every 4 hours, to a maximum of 200 mg.
- If the pregnant woman or girl might be getting too much IV fluid, stop all IV infusions.

Convulsions

Section 11 Medical emergencies in pregnancy-meningitis and malaria

If there are fits, has the pregnant woman or girl got eclampsia? Test the urine for protein and measure her blood pressure.

If she is not suffering from eclampsia, prevent her having more fits with a loading dose and subsequent maintenance doses of phenytoin.

LOADING DOSE Infuse phenytoin 1 g (approximately 18 mg/kg body weight) in 50–100 ml 0.9% saline over 30 minutes (final concentration not to exceed 10 mg per ml):

Note: Only 0.9% saline can be used to infuse phenytoin. Flush IV line with 0.9% saline before and after infusing phenytoin.

Do not infuse phenytoin at a rate exceeding 50 mg per minute due to the risk of arrhythmias, hypotension and respiratory depression.

Complete administration within 1 hour of preparation.

MAINTENANCE DOSE ; Give phenytoin 100 mg IV slowly over 2 minutes or by mouth every 8 hours beginning at least 12 hours after the loading dose.

If **convulsions occur** despite the above give diazepam 10 mg IV slowly over 2 minutes, **OR** if no IV access give rectal diazepam 10mg **OR** rectal paraldehyde 10ml. (see CD/DVD rom).

If **eclampsia is diagnosed**, prevent subsequent convulsions with magnesium sulfate.

Diabetes mellitus in pregnancy

Management

During pregnancy

Insulin dependent pregnant women or girls (**Type 1 Diabetes**)

Signs of hyperglycaemia include a gradual onset of drowsiness and polyuria, dehydration, hypotension, difficulty breathing and a ketotic smell to the breath. Signs and symptoms of hypoglycaemia are usually of rapid onset with sudden onset of unconsciousness, particularly if the pregnant woman or girl has taken insulin but has not taken her usual food.

Delivery

For spontaneous labour, induction of labour and elective Caesarean Section

1. Measure glucose on admission and hourly in labour
2. Site IV line with 500 ml 10% dextrose containing potassium chloride 10mmol and give at 60 ml /hour

Blood glucose mmol/l	Hourly subcutaneous injections of insulin
<2	No insulin –dextrose only
2 to 4.0	1 unit
4.1 to 9.0	2 units
9.1 to11.0	3 units
11.1 to16.9	4 units

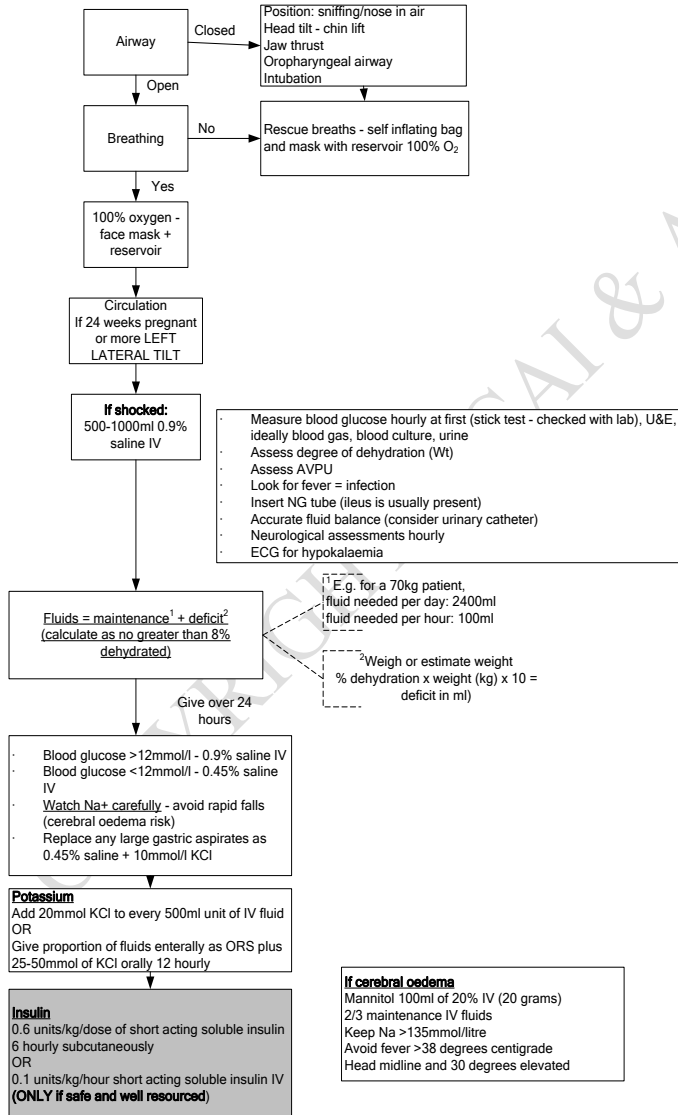
If the glucose level is >17 mmol/l expert advice should be sought

Aim for glucose levels of 4 – 9 mmol/l

Reduce insulin by half at delivery and aim to resume pre-pregnancy insulin dosage 24 hours after delivery. If the mother is breast feeding, her insulin requirement may be lower.

Section 11 Medical emergencies in pregnancy-diabetes

Pathway of care: severe diabetic keto-acidosis in pregnancy



Section 12 Complications of labour and delivery

Section 12 Complications of labour and delivery

Obstructed labour: recognition and early referral Prevention

Good antenatal care so that the position and presentation of the fetus is known before the onset of labour (ideally confirmed by ultrasound examination): IF ABNORMAL POSITION/PRESENTATION, TRANSFER TO HOSPITAL AS SOON LABOUR STARTS.

- Use of the modified WHO partograph
- Good nutritional state in the **pregnant woman or girl**
- Absence of anaemia in the **pregnant woman or girl**
- Adequate fluids and glucose during labour

Dangers of slow progress of labour For the pregnant woman or girl:

- Infection
- Uterine rupture
- Fistulae
- DEATH

For baby

- Infection
- Lack of oxygen to the brain and traumatic injury
- Stillbirth
- Neonatal death
- Permanent brain damage

Main causes of slow progress of labour

1. Poor quality uterine contractions
 2. Mal-presentations and mal-positions
 3. Disproportion between the size of the baby and of the pelvis**
- ** Exclude 1 and 2 before diagnosing this
4. The **pregnant woman or girl** may be dehydrated, ketotic, infected, exhausted

Obstructed labour emergency management

The pregnant woman or girl may be dehydrated, ketotic, septic, and especially if the uterus is ruptured – shocked.

Undertake primary assessment and treatment of **Airway, Breathing, Circulation and Disability**

Depending on the condition of patient, a focused history may be helpful in making a diagnosis (for example, prolonged labour, vaginal bleeding, previous Caesarean section for obstructed labour).

***Emergency resuscitative measures are needed before treating the cause.
ALL NEED URGENT TRANSFER TO HOSPITAL***

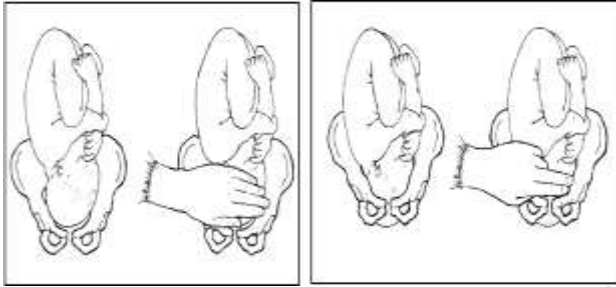
Fetal descent: *By abdominal palpation*

Section 12 Obstructed labour

Fifths of the head palpable above the symphysis:

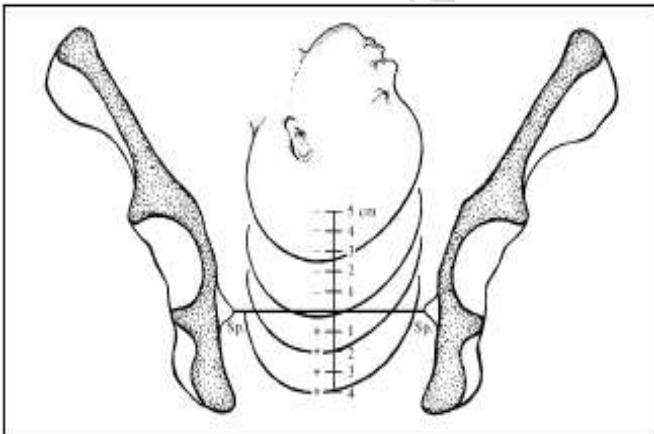
5/5 head entirely above inlet of pelvis

0/5 head deep in pelvis



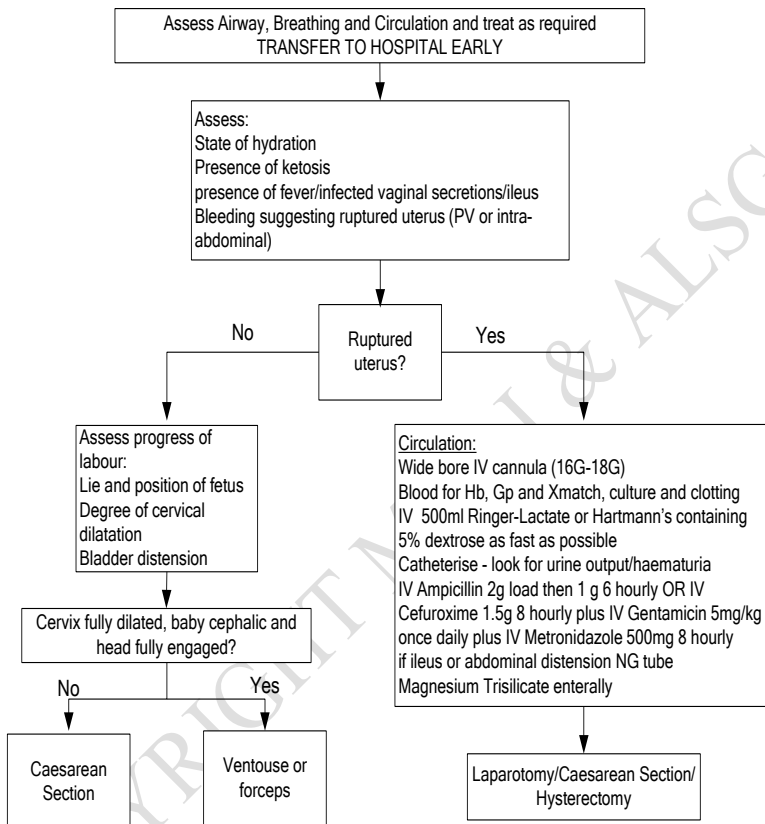
Fetal descent: By vaginal examination

Level of fetal head with respect to the ischial spines = 0 level



Section 12 Obstructed labour

Pathway of Care obstructed labour



Note: also give ampicillin 2g load and 1 g 6 hourly IV if labour > 24 hours (WHO)

Shoulder dystocia

Due to impaction of the shoulders against the bony pelvis. It carries a significant risk to the baby due to hypoxia, fractures of the clavicle and humerus and injuries to brachial nerves.

The problem lies at the **pelvic brim** where the anterior shoulder gets caught, while the posterior shoulder has usually entered the pelvis. Treatment therefore aims to encourage the anterior shoulder into the pelvis, or if this fails either rotating the posterior shoulder round into the anterior position or delivering the posterior arm first. Traction on the head when the anterior shoulder is caught above the pelvic brim will not work and is dangerous. Delivery should occur within five minutes of the delivery of the head and hypoxic injury to the baby is increasingly likely the longer the delay.

Section 12 Shoulder dystocia

Post-partum haemorrhage is common after shoulder dystocia and there is a risk of serious vaginal and perineal lacerations.

Slow progress in labour, particularly in the multiparous patient or a woman with a past history of a big baby or difficulty delivering the shoulders, should alert one to the possibility.

During delivery signs include difficulty delivering the face and chin, head retractions between contractions, head bobbing or the delivered head becomes tightly pulled back against the perineum (turtle sign). As soon as the situation is suspected a plan of action should be initiated.

Management of shoulder dystocia

If risk factors are present, have experienced obstetrician present in 2nd stage
Be prepared for the problem including the PPH that may follow
CALL FOR HELP

1. Episiotomy

A medio-lateral episiotomy is recommended to allow more room for manoeuvres such as delivering the posterior shoulder, allowing the operator to use the sacral hollow and reducing vaginal trauma.

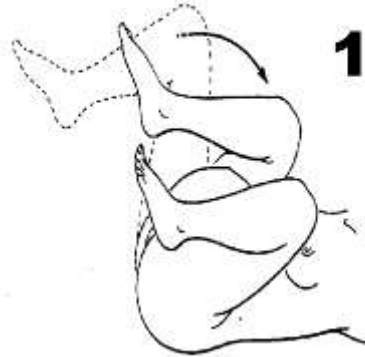
2. McRobert's Manoeuvre

Both thighs are sharply flexed, abducted and rotated outwards ideally by two assistants. Each assistant holds the leg in the region of the thigh and flexes the leg until the thigh lies parallel to the anterior abdominal wall. This will reduce the angle between the sacrum and the lumbar vertebrae to help free the impacted shoulder. If two assistants are not available the pregnant woman or girl may be laid on her left side in the knee to chest position.

3. Suprapubic pressure with moderate traction

Suprapubic pressure is applied to reduce the diameter between the shoulders and push the anterior shoulder underneath the symphysis pubis. It is important to know where the fetal back lies so that pressure is applied in the right direction (that is from the fetal back forwards). Pressure should be applied to the back of the shoulder with the heel of the hand and sometimes a rocking movement may be helpful. Strong traction and fundal pressure should be avoided.

Shoulder dystocia



McRobert's
manoeuvre



McRobert's manoeuvre
and downwards
pressure on the head



4. Apply moderate traction

Once both McRobert's and suprapubic pressure are in place, moderate traction can be applied while discouraging maternal efforts (which can increase the impaction of the shoulders).

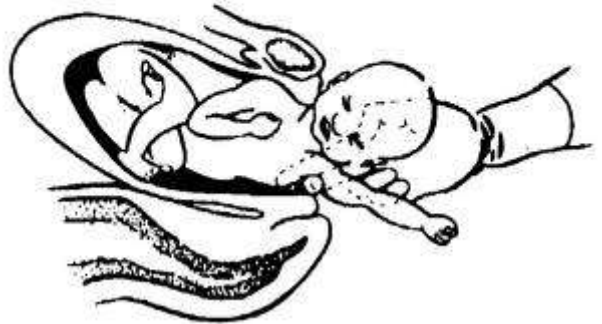
Section 12 Shoulder dystocia

5. Deliver Posterior Arm and Shoulder

Insert a hand up to the fetal axilla and hook the posterior shoulder down. Traction on the posterior axilla then brings the posterior arm within reach: backward pressure on the cubital fossa will disengage the arm which can then be brought down (get hold of the hand and sweep it across the chest).



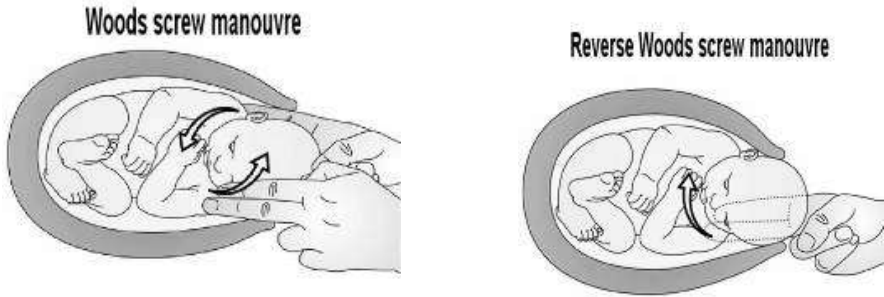
Posterior arm delivered



6. Internal rotational Manoeuvres

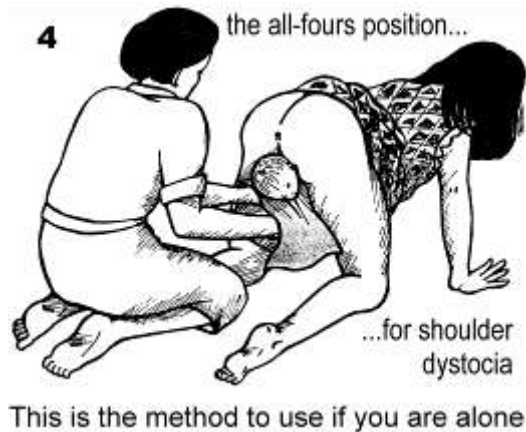
These measures are rarely required. Under full asepsis, the operator inserts the fingers of one hand vaginally, positioning the fingertips behind the anterior shoulder. The shoulder is then pushed towards the fetal chest. If this is unsuccessful the fingers of the opposite hand may be inserted vaginally to approach the posterior shoulder from the front of the fetus. The combination of these two movements may allow rotation of the shoulders and aid delivery. If delivery of the posterior shoulder or arm is not successful try to rotate the posterior shoulder 180 degrees in a corkscrew fashion (clockwise or anticlockwise) to bring it to an anterior position from whence the delivery can continue as normal (this rotation releases the impacted anterior shoulder that ends up in the posterior pelvis). It is important not to twist the fetal head or neck during this manoeuvre.

Section 12 Shoulder dystocia



7. All fours position

This is another procedure which can be useful if no help is available. The pregnant woman or girl positions herself evenly on hands and knees. The above manoeuvres can be performed with the pregnant woman or girl in this position.



8. Symphysiotomy

If the baby is still undelivered symphysiotomy should be considered.

9. Check vagina and perineum for trauma and repair accordingly

Section 12 Vacuum delivery

Instrumental vaginal delivery

1. Ventouse

Indications:

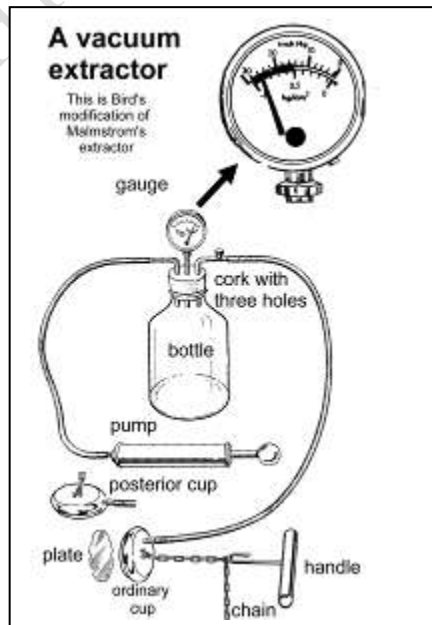
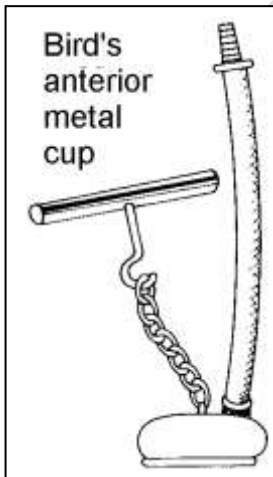
- Delay in the second stage
- Fetal distress in the second stage
- Maternal conditions requiring a short second stage, for example: cardiac failure, diastolic blood pressure > 110 mm mercury.

Contra-indications:

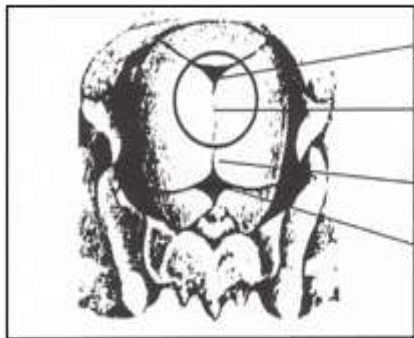
- Cervix not fully dilated
- Face presentation
- Severe clotting disorder
- Gestation below 34 weeks

Delivery with the ventouse: basic rules

- Full dilatation of the cervix and full engagement of the head (less than $\frac{1}{5}$ palpable per abdomen)
- Cleansing of the vulva and vagina with disinfectant solution and sterile drapes
- Position of the baby's head must be known
- Good contractions
- Lithotomy is the position of choice (with a wedge under the right hip for left lateral tilt).
- Place accurately over the flexion point
- The head (not just caput) should descend with each pull. There should be no need for more than 3 pulls
- Careful examination of the perineum and appropriate repair of trauma afterwards
- Detailed documentation including counting of swabs



See



posterior fontanelle

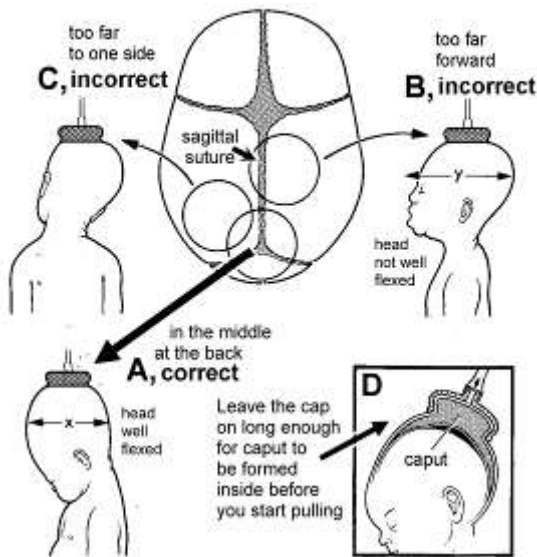
flexion or pivot point

2 finger-breadths or - 3 cm

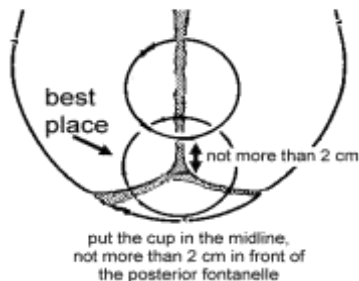
anterior fontanelle

Where to put the cup

And where not to put it!



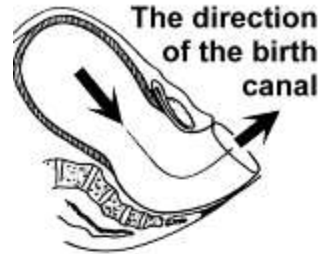
Where to put the cup



THE PLACE WHERE YOU PUT THE CUP is important. Try to place the cup over the baby's posterior fontanel, because this will flex the head.

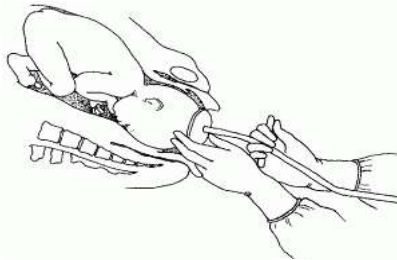
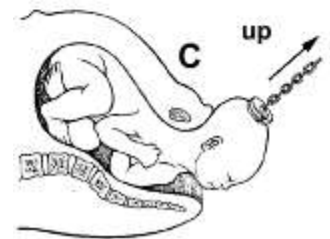
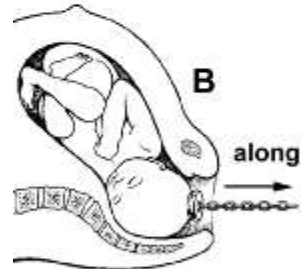
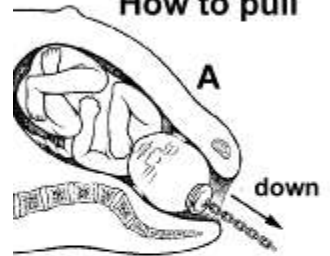
If you put it more towards the front it will extend the head, so that it will be less easy to pull out. The distance "y" when the head is deflexed

Monitor the cup while you pull



PULL IN THE DIRECTION OF THE BIRTH CANAL. First pull downwards towards the floor, until the head is below the ischial spines. Then pull outwards until the head is stretching the perineum. Finally, pull upwards until the baby is delivered.

How to pull



Reasons for failure

1. Incorrect initial assessment (head too high or misdiagnosis of position/attitude of head)

Section 12 Vacuum delivery

2. Incorrect cup placement with the ventouse lateral or too anterior on baby's head.
3. Failures due to traction in the wrong direction (keep hands low).
4. Cephalo-pelvic disproportion (true failure) is rare.

Cup technique

- The appropriate cup should be chosen
- The silicone rubber cup can be used with any well flexed cephalic presentation, provided the baby is average size and there is minimum caput
- The anterior metal cup should be chosen if the baby is big, if the second stage is prolonged or there is a moderate degree or more of caput
- The posterior metal cup should be used for occipital-posterior positions, particularly those with significant deflection of the head
- The cup should be connected to the pump and a check made for leakages prior to commencing delivery. Ensure that the equipment is working properly.

Types of ventouse cup

Silicone cup (see pictures)

- 1 The silicone cup is folded and inserted into the vagina. The cup is positioned against the posterior fontanel.
- 2 The pressure is then taken up to 0.2 kg per square cm and a check made to ensure that no maternal tissue has been caught.
- 3 The pressure can then be increased to 0.8 kg per square cm.
- 4 Traction begins with the next contraction. The line of traction should be along the axis of the pelvis. One hand remains in the vagina against the cup to detect if it becomes detached. The hand in the vagina can help with the flexion of the fetal head.
- 5 As the head crowns, the angle of traction changes to a more upward position. An episiotomy may be required at this stage.

Anterior metal cup

The metal cup is lightly lubricated with sterile jelly and inserted sideways into the vagina. The chain of the cup should lie over the most posterior part of the baby's head. Management after this is as described for the silicone rubber cup.

Posterior metal cup

If the head is deflexed and in an occipital-posterior position the posterior metal cup should be applied.

- 1 It is placed as far back on the head as possible, ideally in the midline.

Section 12 Vacuum delivery

2 An episiotomy may be required to allow adequate access to place the cup and sometimes pressure on the front of the head to encourage flexion may be helpful to ensure proper application.

3 The vacuum is obtained as described before.

4 With the first pull the aim should be to increase the flexion of the fetal head and the procedure then continues as described previously.

Difficult ventouse - Causes

- Wrong diagnosis of the level of the fetal head
- Misdiagnosis of position
- Excess caput
- Incorrect placement of the cup
- Pulling in the wrong direction
- Poor instructions to the pregnant woman or girl

Rarely an **experienced** operator may use the ventouse before full dilatation in an extreme situation of acute fetal distress.

2. Forceps

Only to be undertaken by an experienced operator who is comfortable with the equipment. The ventouse is associated with a lower risk of maternal trauma and should be the first choice. The forceps is the only instrument that can be used in the following circumstances:

- Delivery of the after-coming head of a breech
- Delivery of a mento-anterior face presentation
- Delivery before 34 weeks gestation

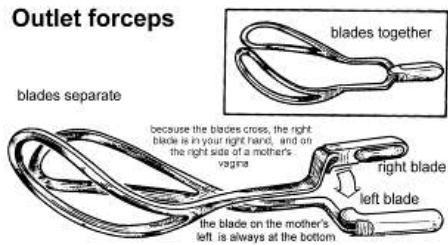
Procedure

- Abdominal examination to confirm that none of the head is palpable
- Clean the vulva and vagina with disinfectant and apply sterile drapes
- Urinary catheterisation
- A pudendal block and perineal local anaesthesia (see CD/DVD rom) is ideal
- Careful vaginal examination to confirm the position of the head
- Check the pair of forceps to ensure they are a matching pair
- The right hand blade is inserted first by passing the right hand into the vagina to lie against the left vaginal wall
- The forceps blade is then passed between the fetal head and the hand to avoid trauma to the maternal vaginal tissues
- After the blade is inserted the handle will lie horizontally at the perineum
- The left blade is inserted by a similar technique and the blades are then locked
- Downward traction should be applied with the next contraction
- The head should descend with each pull and no more than 3 pulls should be undertaken
- An episiotomy is usually required as the head crowns

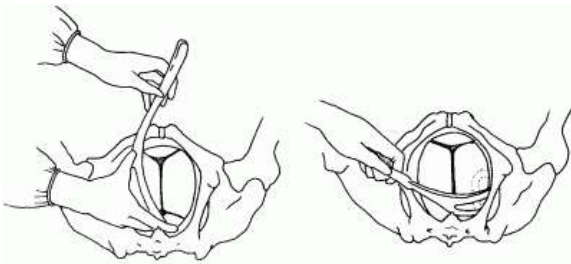
Section 12 Forceps

- After delivery of the placenta, the vagina and the perineum should be checked and repaired
- Care should be taken that all swabs and instruments are correct and a rectal examination should be performed to ensure that rectal tears are recognised and that sutures have not been placed into the rectum
- The technique for rotational forceps is outside the requirement of this manual and should only be undertaken by an expert in the field

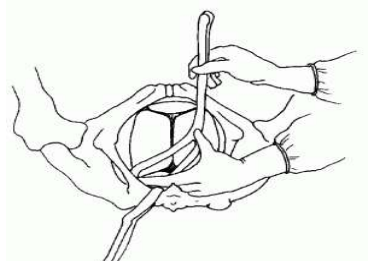
OUTLET FORCEPS are very useful for delay in the second stage when a baby's head is near the outlet. The blade on the mother's left always goes in first, and the right blade fits on top of



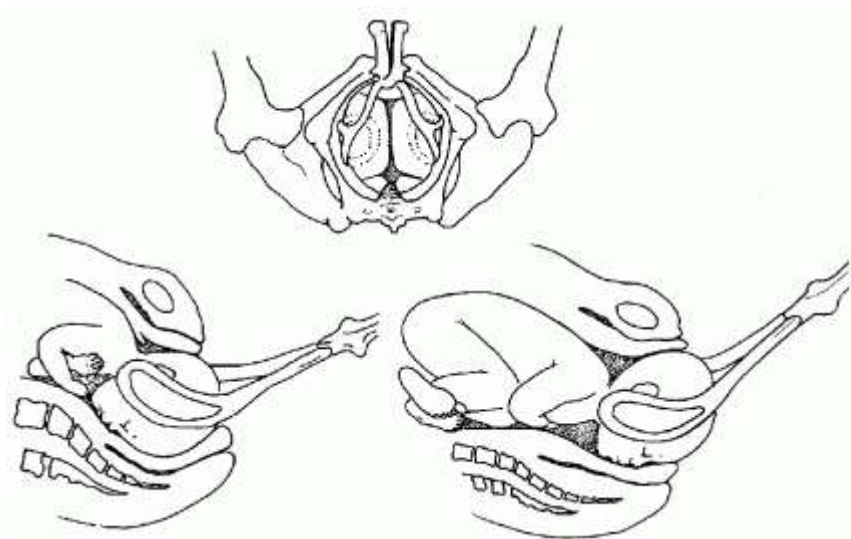
Applying the left blade of the forceps



Applying the right blade of the forceps



Locking and applying traction



Twin pregnancy

Maternal risks associated with multiple pregnancy

- Miscarriage
- Anaemia
- Pre-term labour
- Hypertension
- Excess liquor (polyhydramnios)
- Operative delivery
- Post-partum haemorrhage

Fetal risk associated with multiple pregnancy

- Stillbirth or neonatal death
- Pre-term delivery
- Intra-uterine growth restriction
- Congenital abnormalities
- Cord accident
- Specific complications of twin pregnancies, e.g. twin to twin transfusion syndrome
- Difficulties with delivery

If the pregnant woman or girl her develops premature labour, ante-natal steroid injections (betamethasone 12 mg IM repeated once after 24 hours) may improve the maturity of the fetal lungs and reduce the risk of respiratory distress syndrome in the newborn.

Section 12 Twins

Twin delivery

Vaginal delivery is usually safe, but consideration may need to be given to Caesarean Section if conjoined or mono-amniotic twins are suspected. If the first twin is a breech or either twin has severe growth restriction, Caesarean Section may be appropriate.

The management of labour

On admission insert an IV line. Blood for a full blood count, blood group and cross-match. Ultrasound assessment of presentation will help with management. The anaesthetist, paediatrician and neonatal unit should be informed of admission.

The first stage of labour is managed as a singleton pregnancy.

Management of second stage

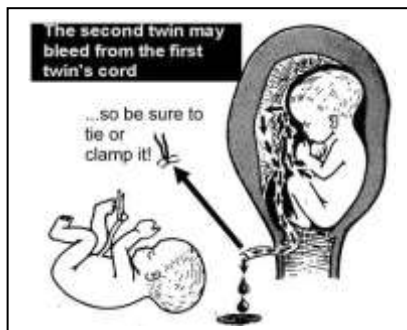
Deliver first twin as normal. Examine abdomen to determine lie of second fetus and monitor fetal heart closely. If the lie is transverse, attempt external cephalic version to turn the baby to cephalic presentation. If unsuccessful attempt internal podalic version by grasping the fetal foot and pulling along the birth canal, leaving the membranes intact as long as possible.

If no contractions have re-started within ten minutes of delivery of the first baby and the baby is lying longitudinally, an oxytocin infusion of 5 units in 500ml of 0.9% saline or Ringer-Lactate or Hartmann's (that is 10 milliunits/ml) should be started at a rate of 1 milli-units/ minute (6ml/hour) increasing to achieve adequate contractions. When the presenting part is well into the pelvis, rupture of membranes can be performed during a uterine contraction. Delivery of the second baby should not be rushed but assisted delivery should be considered if the baby has not been delivered by 30 minutes after delivery of the first. (WHO gives no time scale for the delivery of the second baby)

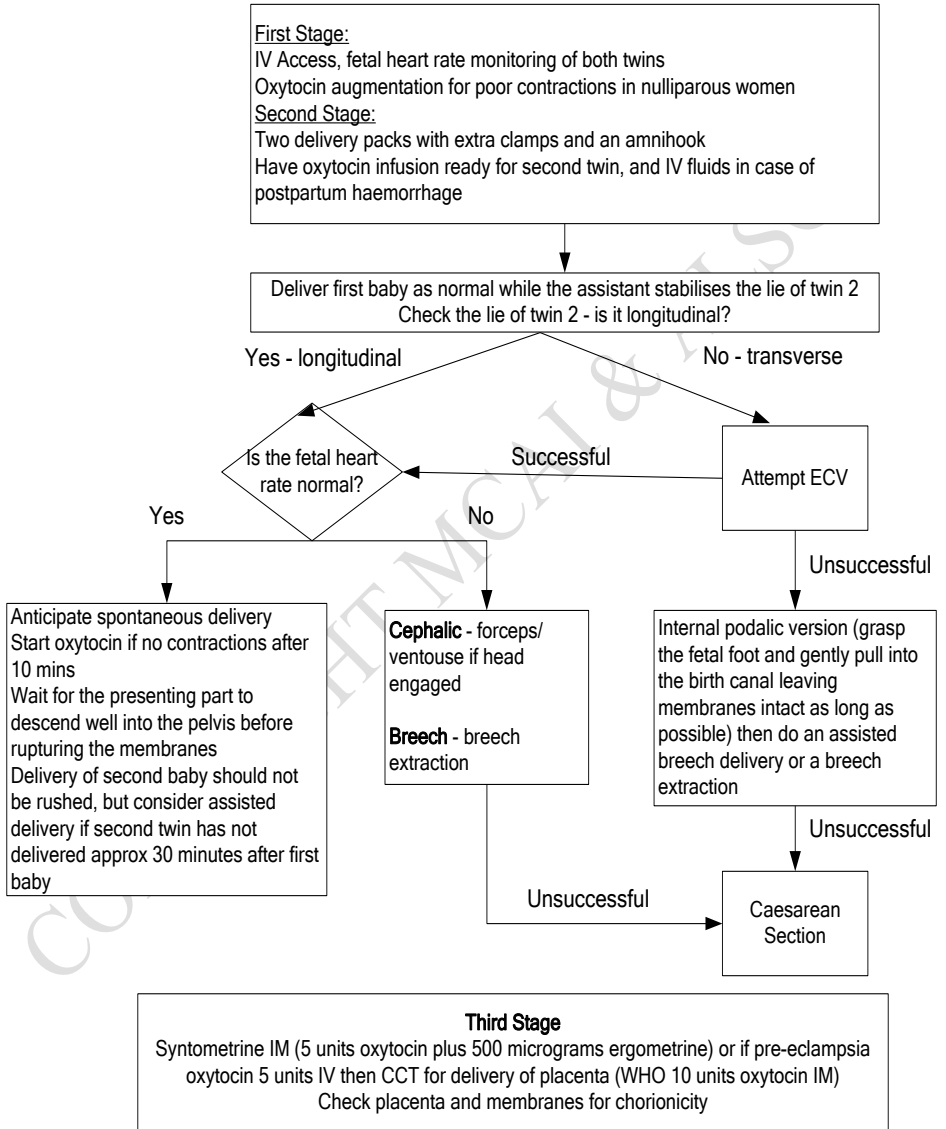
After delivery of the second baby syntometrine IM (5 units oxytocin plus 500 micrograms of ergometrine) should be administered. (WHO 10 IU oxytocin IM after ensuring that there is no other baby in the uterus). If the pregnant woman or girl has hypertension 5 units of oxytocin should be given IV instead. After placental delivery commence infusion of oxytocin 40 units in 500 ml. 0.9% saline or Ringer-Lactate or Hartmann's over 4 hours to improve uterine contraction after delivery and reduce the risk of postpartum haemorrhage.

Check the placenta and membranes for the number of amnions and chorions which will reveal whether the babies are identical or not. Also check for completeness.

Check and repair any vaginal and perineal damage. Monitor carefully for post-partum bleeding over the next few hours. Provide extra support to assist with the care of the babies.



Pathway of Care for Delivering Twins

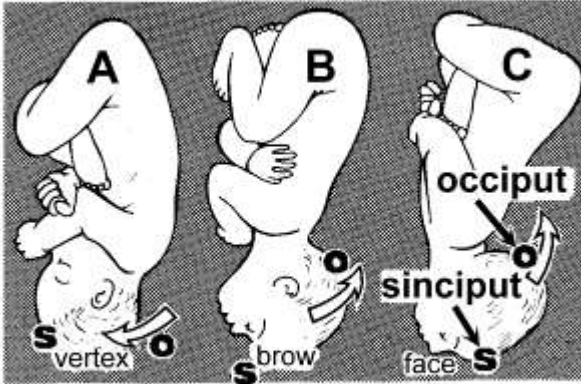


Section 12 Malpresentations and malpositions

Malpresentations and malpositions

These can be due to fetal or maternal pathology, which should be diagnosed antenatally if possible.

Flexion and extension

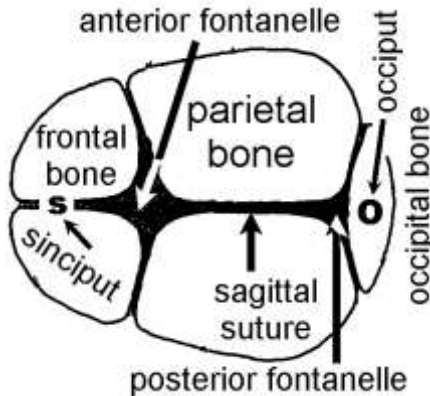


fully flexed
vertex
presentation

partly deflexed
brow
presentation

completely
deflexed,
face presentation

FLEXION AND EXTENSION. Baby A's head is fully flexed on the chest so that the vertex is presenting. Baby B's head is partly deflexed so that the brow is presenting. Baby C's head is fully deflexed so that the face is presenting. Deflexion is another word for the first part of extension. Only A is normal, the others are abnormal and difficult to deliver unless the baby is very small, especially B.



Section 12 Malpresentations and malpositions

Table: diagnosis of malpositions

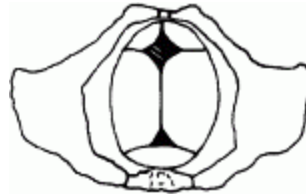
Symptoms and Signs

OCCIPUT POSTERIOR POSITION occurs when the fetal occiput is posterior in relation to the maternal pelvis

On **abdominal examination**, the lower part of the abdomen is flattened, fetal limbs are palpable anteriorly and the fetal heart may be heard in the flank.

On **vaginal examination**, the posterior fontanelle is towards the sacrum and the anterior fontanelle may be easily felt if the head is deflexed.

Figure



Occiput posterior

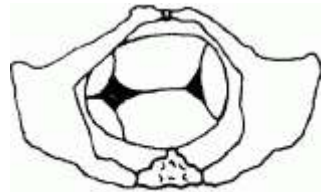


Left occiput posterior

Section 12 Malpresentations and malpositions

Symptoms and Signs

OCCIPUT TRANSVERSE POSITION occurs when the fetal occiput is transverse to the maternal pelvis. If an occiput transverse position persists into the later part of the first stage of labour, it should be managed as an occiput posterior position.



Left occiput transverse

BROW PRESENTATION is caused by partial extension of the fetal head so that the occiput is higher than the synciput.

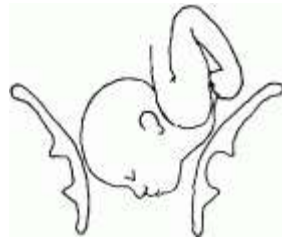
On **abdominal examination**, more than half the fetal head is above the symphysis pubis and the occiput is palpable at a higher level than the synciput.



On **vaginal examination**, the anterior fontanelle and the orbits are felt.

FACE PRESENTATION is caused by hyper-extension of the fetal head so that neither the occiput nor the synciput are palpable on vaginal examination.

On **abdominal examination**, a groove may be felt between the occiput and the back.



On **vaginal examination**, the face is palpated, the examiner's finger enters the mouth easily and the bony jaws are felt.



Section 12 Malpresentations and malpositions

Symptoms and Signs

Figure

COMPOUND PRESENTATION occurs when an arm prolapses alongside the presenting part. Both the prolapsed arm and the fetal head present in the pelvis simultaneously.



BREECH PRESENTATION occurs when the buttocks and/or the feet are the presenting parts.

On **abdominal examination**, the head is felt in the upper abdomen and the breech in the pelvic brim. Auscultation locates the fetal heart higher than expected with a vertex presentation.

On **vaginal examination during labour**, the buttocks and/or feet are felt; thick, dark meconium is normal.



COMPLETE (FLEXED) BREECH PRESENTATION

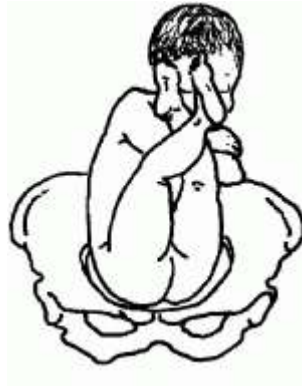
occurs when both legs are flexed at the hips and knees.

FRANK (EXTENDED) BREECH PRESENTATION

occurs when both legs are flexed at the

Section 12 Malpresentations and malpositions

hips and extended
at the knees.



FOOTLING BREECH PRESENTATION

occurs when
a leg is extended at the hip and the knee.



TRANSVERSE LIE AND SHOULDER PRESENTATION occur when the long axis of the fetus is transverse. The shoulder is typically the presenting part

On **abdominal examination**, neither the head nor the buttocks can be felt at the symphysis pubis and the head is usually felt in the flank.



On **vaginal examination**, a shoulder may be felt, but not always. An arm may prolapse and the elbow, arm or hand may be felt in the vagina.

Section 12 Malpresentations and malpositions

Face presentation

This is due to extension of the fetal neck, either from a fetal abnormality or progression from a deflexed occipital posterior position in labour. Diagnosis is important as it may be mistaken for breech presentation.



a face presentation

Diagnosis

On abdominal examination a large amount of the head is felt on the same side as the back.

Vaginal examination

In early labour the presenting part will be high. Landmarks are the mouth, jaws, nose, malar and orbital ridges. The presence of alveolar margins distinguishes the mouth from the anus. The mouth and the maxilla (upper jawbone) form the corners of a triangle, while the anus is on a straight line between the fetal pelvic bones. Avoid damaging the eyes by trauma or the use of antiseptics. Ventouse must not be used.

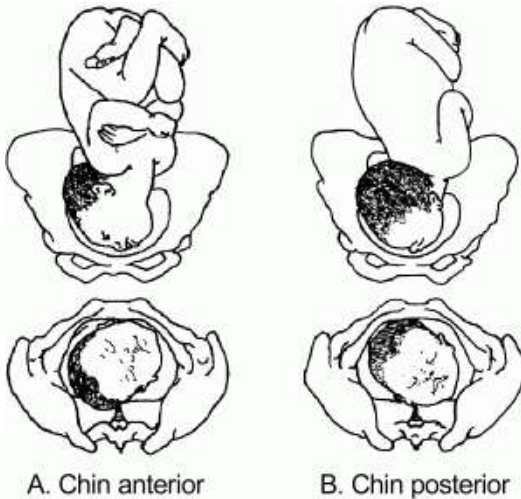
Section 12 Malpresentations and malpositions

In early labour, particularly with the occipito-posterior position and multiparous patient deflexion is common, but in such cases uterine contractions often cause increased flexion and delivery will proceed as normal. If extension occurs however, a brow presentation and finally the fully extended face will result. Most face presentations therefore only become obvious late in labour. If the chin is towards the pubis (mento-anterior) then the baby can often be delivered normally although an episiotomy is usually necessary. If the chin lies towards the back then delivery will not occur and a Caesarean Section will be required. The widest biparietal diameter is 7cm behind the advancing face, so even when the face is distending the vulva, the biparietal diameter has only just entered the pelvis. Descent is less advanced than VE suggests, even allowing for gross oedema. The head is always higher than you think.

Abdominal examination is vital.

The head is born by flexion, risking considerable perineal trauma – consider an episiotomy.

If spontaneous delivery of a mentoanterior face does not occur a “lift out” forceps delivery can be performed (see section on forceps delivery)



Occipito-posterior (OP) position

This is common, occurring in up to 20% of laboring pregnant women or girls.

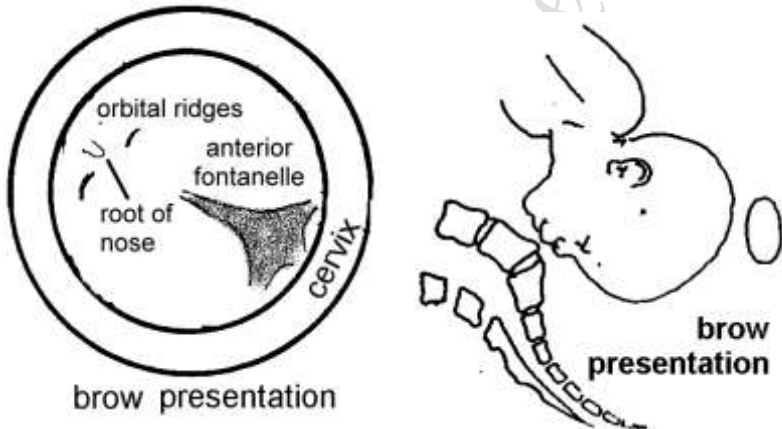
Diagnosis

Abdominal examination may show flattening of the abdomen, difficulty feeling the back, the limbs may be felt anteriorly. Vaginal examination reveals a high deflexed head and the posterior fontanelle of the fetal skull is felt towards the sacrum. In pregnant women or girls with an anthropoid pelvis, for example those from Africa, the OP may be normal and delivery may occur in the OP position. The first stage of labour in pregnant women or girls with a gynaecoid pelvis (the more common female pelvis shape), may be prolonged and an

Section 12 Malpresentations and malpositions

oxytocin infusion may be required. Assisted delivery is often required. If there is delay in the second stage of labour ventouse is the preferred method of delivery and if available the OP cup should be used. A rotational forceps delivery with the Kiellands forceps should only be undertaken by someone with extensive experience of the procedure. The OP position may cause a positional cephalo-pelvic disproportion and Caesarean Section may be required, particularly if cervical dilation stops.

Brow presentation This is usually caused by partial extension of the fetal head and may be suspected on abdominal examination as more than half the head is felt above the symphysis on the side of the fetal back. Vaginal examination will reveal the anterior fontanel and bony ridges above the eyes. Unless the head extends further to face presentation, vaginal delivery is not possible and Caesarean Section will be required.



Compound presentation

Here more than one part of the fetus is facing the cervix, for example an arm prolapsing alongside the presenting part. It is more common in prematurity. It can be managed expectantly in the early stages of labour in the multiparous patient, with active treatment only being required if there is a delay in the first or second stages of labour.

Section 12 Breech

Breech presentation

At 28 weeks, 20% of babies present by the breech, but most fetuses will turn spontaneously so that only 3-4% will remain breech at term. There is a higher risk with prematurity. Vaginal delivery (although safer for the pregnant woman or girl than Caesarean section) carries higher risk of perinatal and neonatal mortality and morbidity due to birth asphyxia and trauma.



extended
legs



flexed
legs



footling



a single
presentation

External cephalic version

This may be performed between 37 and 42 weeks if there is a single uncomplicated breech pregnancy. There should be no previous uterine scars, no previous ante-partum bleeding, no fibroids nor placenta praevia. On admission the fetal heart should be monitored. If available, ultrasound should be performed to demonstrate the fetal position, a good amount of liquor, a flexed fetal head and the position of the fetal legs. The pregnant woman or girl should be awake and consent to the procedure.

Procedure:

External cephalic

version

Tilt the bed head down to allow gravity to assist in disengaging the breech.

The pregnant woman or girl lies on her side to allow a forward somersault.

The abdominal wall should be covered with talcum powder, almond or

vegetable oil or ultrasound gel to help to turn the baby. The breech should be disengaged with one hand and an attempt made to turn the baby with the other. No more than three attempts should be made. Whether or not the procedure is successful, the fetal heart should be listened to every 5 minutes for an hour. If the pregnant woman or girl is rhesus negative a Kleihauer test should be performed and 500 international units of anti-D administered to the pregnant woman or girl IM.

All pregnant women or girls should be warned about the risks of reduced fetal movements, bleeding, rupture of the membranes or onset of labour. If successful the pregnancy can be managed as a cephalic



Section 12 Breech

presentation. If unsuccessful, future management should be discussed and a decision made regarding elective Caesarean Section or trial of vaginal breech delivery.

Trial of vaginal breech delivery

This is appropriate if:

- The pregnant woman or girl **and** baby are of normal proportions
- presentation of breech is frank (hips flexed, knees extended) or complete (hips flexed, knees flexed but feet not below the fetal buttocks)
- no evidence of fetal-pelvic disproportion: adequate pelvis - using clinical judgment - and estimated fetal weight <4000g (clinical measurement)
- no evidence (on ultrasound) of hyper-extension of the fetal head.
- The pregnant woman or girl should be counseled and given informed choice
- Inform theatre and the on-call anaesthetist
- Careful fetal monitoring and documentation of the partogram
- Amniotomy may be used to accelerate labour and careful use of oxytocin may be used to correct poor uterine activity if the pregnant woman or girl is having her first baby. Oxytocin should not be used for poor progress in a pregnant woman or girl who has previously given birth
- Caesarean Section should be considered if there is poor progress or fetal distress
- Ensure an obstetrician with adequate experience in delivering breech babies vaginally is present during the second stage

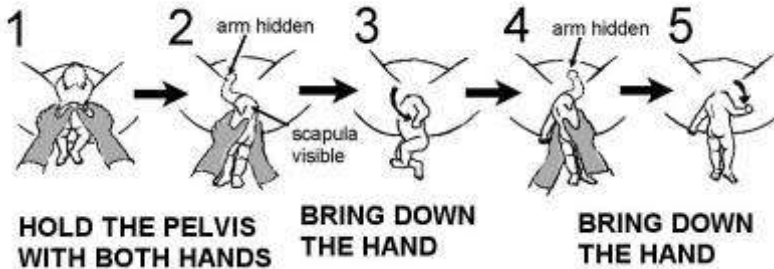
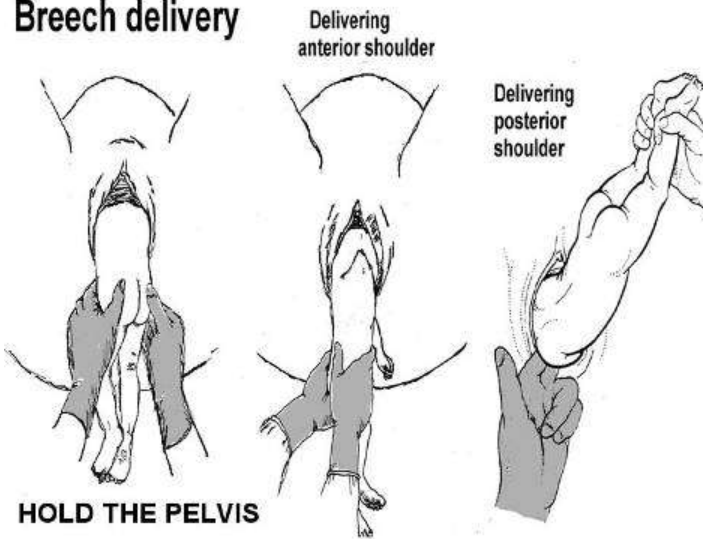
The basic principles of delivering a breech are those of not interfering

- Active pushing should not be encouraged until the breech has descended to the pelvic floor. Sitting the patient up at this stage may help to encourage descent of the breech. An **episiotomy** may well be required, but should not be performed until the anus is visible. (WHO until baby's buttocks are distending the perineum)
- The breech will usually rotate spontaneously to lie with the sacrum anteriorly. It must be prevented from turning posterior. Extended legs are delivered by flexing the knee joint of the baby and then extending at the hips
- The baby is supported only when the arms are delivered and the nape of the neck becomes visible (avoid holding the baby's abdomen - the pelvis can be held gently)
- As the pregnant woman or girl pushes, the anterior shoulder tip will become visible. A finger is run over the shoulder and down to the elbow to deliver the arm. The other shoulder will rotate anteriorly spontaneously to allow similar delivery of the other arm
- The baby lies supported as the head engages and the neck comes into view. Delivery of the head may then be performed by the Maurice-Smellie-Veit manoeuvre. The right hand is placed into the vagina, the fetus is supported on the right forearm, the first and middle fingers are placed against the cheekbones. Pressure is applied on the tongue to flex and deliver the head. The left hand is used to encourage flexion. Alternatively to achieve the controlled head. The left hand is used to encourage flexion. Alternatively to achieve the controlled head. An assistant should hold the the body above the horizontal access to apply forceps. The be in view before the baby's or damage to the fetal neck head fails to descend into the of the neck does not appear, a be considered.

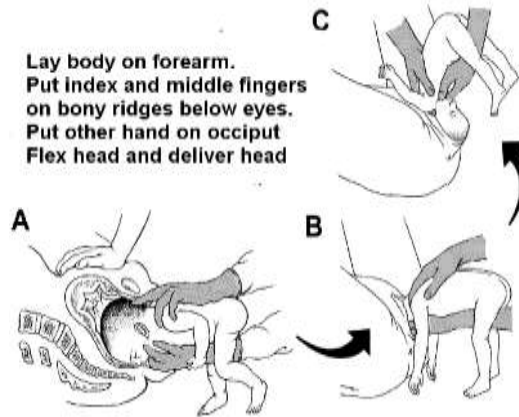


The baby should be left to hang until the nape of the neck is seen

Breech delivery



Section 12 Breech



Elective Caesarean section

The pregnant woman or girl must understand the risks of Caesarean section and the concept of trial-of-scar in a future pregnancy.

- Ensure presentation remains breech before anaesthetising patient.
- Take care on entering the uterus – the breech is much more likely to be cut than if presentation is cephalic
- Make the uterine incision of good size (if too small there can be difficulty delivering the head)

Transverse and Oblique Lies

Background

These are particularly associated with prematurity, uterine fibroids, and placenta praevia and consequently are associated with high maternal and fetal morbidity. Always try to identify the underlying pathology.

The resulting presentation of shoulder, limb or cord means that Caesarean section is the only option for delivering a viable infant. If the fetus is dead, unless it is very small and macerated, it is safer to perform a destructive procedure (see CD/DVD rom)

Practical points to remember

- Try to identify the cause of the abnormal lie (ultrasound)
- Positively exclude placenta praevia with ultrasound before conducting digital vaginal examinations
- Caesarean section can be extremely difficult:

Section 12 Prolapsed cord

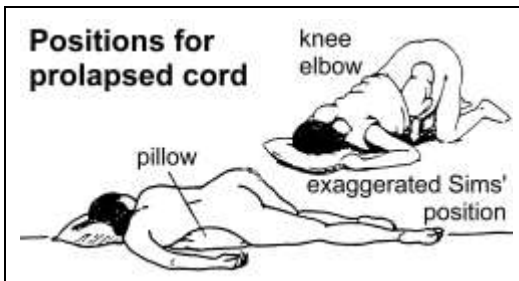
- The lower segment will be poorly formed
- Fibroids when present can distort anatomy and inhibit access
- Placenta praevia is associated with severe haemorrhage
- A vertical uterine incision may be most appropriate for above reasons
- Keep the membranes intact while making and extending the uterine incision as this helps with manipulating the fetus into a longitudinal plane for delivery
- If there is any difficulty in delivering a fetal head or breech then find, grasp and bring down a foot (recognisable by the heel) into the wound.
- If delivery is still impossible the uterine incision can be extended.

Prolapsed umbilical cord

Management

1 ASSESS VIABILITY

If the baby is alive and of a viable gestation (the cord will be pulsating and the fetal heart sounds heard), elevate the presenting parts and ensure rapid delivery. Give the pregnant woman or girl 100% oxygen to breathe and place in the knee elbow or left lateral tilt position.

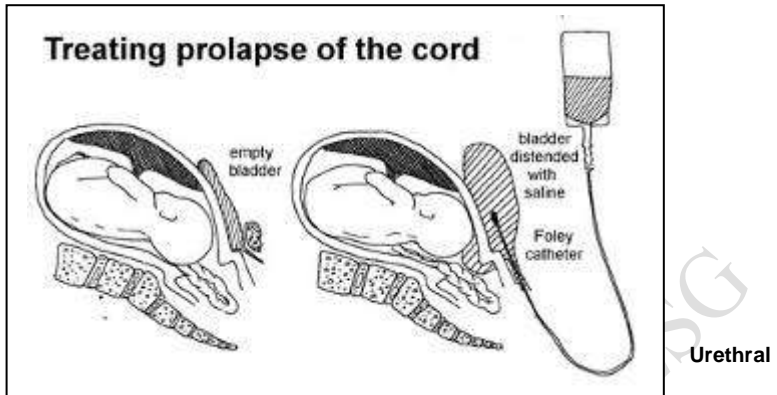


The interval between diagnosis and delivery is significantly positively correlated with still birth and neonatal death. If the baby is dead, deliver in the safest way for the pregnant woman or girl.

2 RELIEVE COMPRESSION

- a) knee chest or Trendelenburg positioning and manual elevation (using high level sterile gloves) of the presenting part above the pelvic inlet to relieve compression. Ensure sterile procedures including cleaning the perineum.
- b) prepare for emergency Caesarean section, assuming that this can safely be undertaken
- c) fill the bladder to raise the presenting part off the compressed cord for an extended period of time, allowing the operator to remove his or her fingers from the presenting part. Insert sufficient 0.9% saline or Ringer-Lactate or Hartmann's so that the distended bladder appears above the pubis: 500 ml is usually sufficient. Inflate the balloon of the foley catheter, clamp it and attach drainage tubing and urine bag. The full bladder may also decrease or inhibit uterine contractions. The bladder must be emptied by unclamping the catheter before opening the peritoneal cavity for Caesarean section. Mark the abdomen to show the bladder is inflated.

Section 12 Prolapsed cord



Catheterisation

Methods:

Use appropriate size of catheter i.e. one that is smaller in diameter than the external urethral meatus (to minimise risk of subsequent urethral stricture formation). Do not attempt to use a tube larger than the meatus. Sterile lubricant should be used.

Use sterile precautions (gloves etc), wash area with antiseptic, catheter bag if available, syringe of 0.9% saline or Ringer-Lactate or Hartmann's to inflate balloon if is Foley balloon catheter and an assistant to hold legs apart. No need for force. Catheter is in sufficiently far when urine is seen in tube.

3 SUPPORT the pregnant woman or girl AND BABY

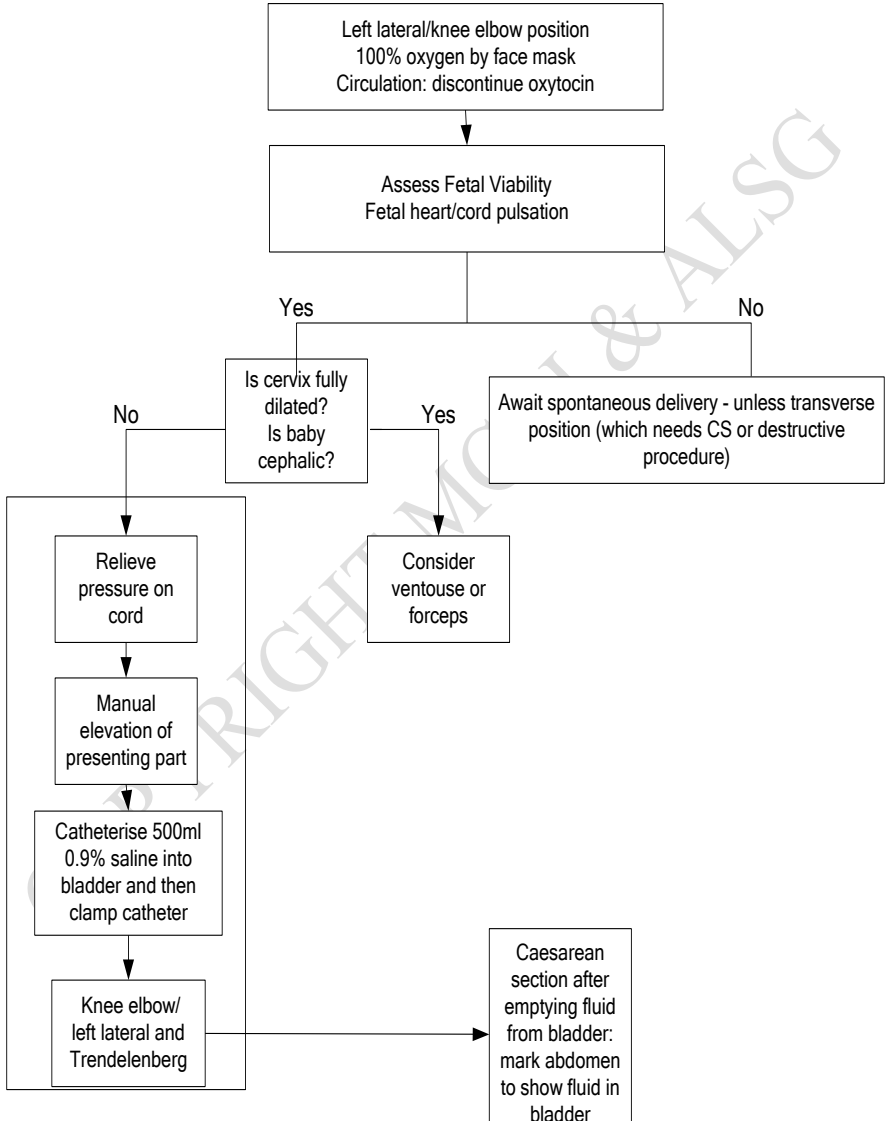
- give the pregnant woman or girl 100% oxygen to breath (face mask and reservoir)
- discontinue any oxytocin infusion
- ensure IV access

4 DELIVER BABY

- Cord prolapse at full cervical dilatation with a live viable fetus is an indication for using a ventouse with an un-engaged head. If ventouse is not available and the head is engaged forceps may be used.
- if the cervix is not fully dilated Caesarean section if safe will be required. At skin incision the bladder clamp must be released and the bladder emptied.

Section 12 Prolapsed cord

Pathway of Care Prolapsed Cord



SECTION 13 Care of the Newborn infant at Birth

1. RECOGNISING THE BABY AT RISK

Preterm birth

Defined as: less than 37 weeks gestation. Maturity matters more than birth weight.

Preventative Strategies may include:

Minimising the risk of surfactant deficiency

Can be halved if the pregnant woman or girl is given a short course of high dose steroid treatment before delivery. Give two 12 mg doses IM or oral betamethasone or dexamethasone 24 hours apart.

Stopping premature uterine contractions

Crush a 10 mg nifedipine capsule between the teeth to achieve sublingual absorption. Up to three further doses can be given at 15 minute intervals if uterine contractions persist.

If this stops labour give 20 mg -50mg of a slow release tablet three times a day for the next three days.

Other problems associated with preterm birth

1. **Nutrition**
2. **Infection**
3. **Hypothermia**

1 Nutrition

Babies born before 36 weeks of gestation nearly always need some help with feeding. Breast milk is ideal, and everything possible should be done to help the mother sustain her lactation until the baby is ready to feed reliably from the breast. Ability to suck and swallow remains unpredictable, unreliable and uncoordinated until 36 weeks gestation. Partial breast feeding can also help the mother to sustain her lactation the mother should regularly express milk. Expressing breast milk may be difficult for some mothers.

2 Infection

- Ascending infection may be symptomatic or asymptomatic.
- Treatment needs to protect against group B streptococcal, coliform and Listeria infection, making a **combination of ampicillin and gentamicin** the best strategy for the newly born.
- Treatment needs to be considered in any pregnant woman or girl going into active spontaneous labour before 35 weeks gestation. It should also be considered at *any* gestation if the pregnant woman or girl's membranes rupture more than six hours before other signs of overt labour develop (because membrane rupture can be both a sign of, and a risk factor for, ascending bacterial infection).
- Premature rupture of membranes (PROM) where the membranes rupture before there are detectable uterine contractions. When *this* happens in the preterm baby it is often a sign of ascending infection

[1] In mothers with PROM who show signs of being clinically infected give antibiotics.

[2] In PROM where there is no evidence of infection and no evidence of labour you can delay delivery by a week or more by giving the mother amoxicillin or, better still, erythromycin.

[3] In mothers who are in active labour five or more weeks before term and who give a clear history that the membranes had ruptured before they were able to detect any uterine contractions the risk of the baby becoming infected during delivery can be reduced substantially by giving antibiotics (ideally probably both penicillin and gentamicin) during labour.

- A maternal temperature in excess of 38°C during labour is an important but uncommon sign of early ascending infection.
- Many of the babies who become infected during delivery develop respiratory symptoms very soon after birth, but in a few the features are those of neonatal sepsis.

3. Hypothermia

Seriously increases the risk of surfactant deficiency and hypoglycaemia and must be avoided.

2. PREPARATION FOR BIRTH

EQUIPMENT NEEDS FOR CARE OF THE NEWLY BORN

- A clean dry towel
- A firm working surface
- A good soft well-fitting face mask (size 0/1 and 00)
- T piece and manometer/pressure gauge or Self inflating bag and reservoir
- A source of air or oxygen (it does not need to be oxygen)
- A pressure limiting device at 30 cm H₂O
- A stethoscope
- Laryngoscope and set of suitable sized ET tubes (2.5, 3.0 and 3.5mm)
- Suction devices: ideally mechanical plus wide bore suction tubes and those suitable for ET tubes
- Umbilical venous catheter plus Ringer-Lactate or Hartmann's
- Clock
- Roll of zinc oxide tape for name-band
- Pulse oximeter (ideal)
- Heat source

3. MANAGEMENT AT DELIVERY

Summary of management of the healthy baby at birth

1. Clamp cord when pulsation stopped
2. Prevent hypothermia
3. Early feeding
4. Minimise risk of infection
5. Injection Vitamin K

Preventing heat loss after birth

As long as the baby becomes pink, and starts to breathe without distress, most babies must be with their mothers and have a first feed at the breast within minutes of birth. Colostrum is extremely nutritious and all mothers should be informed that it is ideal for their baby to feed on this as soon after birth as possible.

Babies very easily get cold immediately after birth, and using water or oil to clean the skin within four hours of birth before body temperature has stabilised can make the baby dangerously hypothermic (a problem that may well be missed if a low reading thermometer is not used). Nothing is a more effective source of warmth than the mother's own body as

Section 13 Care of the newborn at birth

long as the baby is first gently dried to minimize evaporative heat loss and mother and baby are then both protected from draught.

Heat and water loss through the skin can be a particular problem in babies born before 32 weeks gestation. This can be limited by wrapping all but the face in a plastic drape for a few hours after birth.

Covering the head with a shawl or blanket also reduces heat loss from the head (babies have relatively big heads). Remember, however, that plastic over the face can cause death from suffocation.

A larger sheet or blanket can be used to protect both mother and baby from the convective heat loss caused by draughts.

Heat supplementation can be provided by locally built and maintained incubators, overhead heating systems and by Kangaroo care.

Managing the placenta, cord and umbilical stump

- Wait a minute before cutting the cord if it is still pulsating unless there is an overriding need to start stabilising the baby.
- The cord must be cut cleanly in a way that avoids even the slightest risk of tetanus developing, and the cut stump secured in such a way that minimises the risk of late haemorrhage.
- The umbilical stump will shrink as it dries out. Plastic clamps that shut down further as the cord starts to shrink are very effective. They are relatively inexpensive, and they do make it possible to cut the stump short (about a centimeter from the skin). An elastic band is a cheap, and well tried, alternative. A stump that is left long provides a reservoir where bacteria can breed and multiply with great speed. A short stump does not need to be covered except to keep it from snagging on clothes and blankets. It will also wither and fall off quicker if kept dry, left exposed and not routinely treated with any antiseptic lotion or powder.
- A little 'stickiness' is of no concern but a local antiseptic should be applied if a red skin flare suggests early spreading staphylococcal cellulitis. Some of these babies also merit an oral anti-staphylococcal antibiotic. Oral cloxacillin or oral flucloxacillin (25 mg/kg three times a day) is usually the most logical choice, but babies who become systemically unwell need urgent broad-spectrum antibiotic IV or IM
- Any residual risk of neonatal tetanus can be eliminated by ensuring that all pregnant women or girls are themselves immunised against tetanus before delivery.

The risk of cross-infection during or after birth

Antibiotic treatment has reduced the risk of death, but it has not lessened the need for meticulous hand washing. Failure to observe this simple but important precaution also puts the baby at risk of cross-infection, especially if the baby is being cared for in a hospital setting.

3. RESUSCITATION OF THE TERM BABY AFTER BIRTH

Sequence of actions during resuscitation of the newly born

FIRST Keep the baby warm and assess

Babies are born small and wet. They get cold very easily, especially if they remain wet and in a draught.

Whatever the problem, first make sure the cord is securely clamped and then dry the baby, remove the wet towels, and cover the baby with dry towels.

Section 13 Resuscitation of the newly born

For significantly preterm babies (30 weeks and below), there is now good evidence that placing the baby under a radiant heater and, without drying the baby beforehand, immediately covering the head and body, apart from the face, with food-grade plastic wrapping, is the most effective way of keeping these very small babies warm during resuscitation or stabilisation at birth.

Drying the baby will provide significant stimulation and will allow time to assess colour, tone, breathing, and heart rate.

Reassess these observations regularly (particularly the heart rate) every 30 sec or so throughout the resuscitation process. The first sign of any improvement in the baby will be an increase in heart rate.

Consider the need for help; if needed, ask for help immediately.

A healthy baby will be born blue but will have good tone, will cry within a few seconds of delivery, will have a good heart rate (the heart rate of a healthy newborn baby is about 120-150 beats min⁻¹), and will rapidly become pink during the first 90 sec or so. A less healthy baby will be blue at birth, will have less good tone, may have a slow heart rate (less than 100 beats min⁻¹), and may not establish adequate breathing by 90-120 sec. An ill baby will be born pale and floppy, not breathing and with a slow or very slow heart rate.

The heart rate of a baby is best judged by listening with a stethoscope. It can also be felt by gently palpating the umbilical cord but a slow rate at the cord is not always indicative of a truly slow heart rate - feeling for peripheral pulses is not helpful.

Second A Keep the airway open

- Before the baby can breathe effectively the airway must be open.
- The best way to achieve this is to place the baby on his/her back with the head in the **neutral position**, i.e. with the neck neither flexed nor extended. Most newborn babies will have a relatively prominent occiput, which will tend to flex the neck if the baby is placed on his/her back on a flat surface. This can be avoided by placing some support under the shoulders of the baby, but be careful not to overextend the neck.
- If the baby is very floppy it may also be necessary to apply chin lift or jaw thrust. The best way to stabilise a baby's condition at birth is to ensure that the upper airway remains unobstructed. The baby will then have little difficulty in drawing air into its lung for itself when it takes its first spontaneous gasp or cry. Unfortunately books often talk of the need to keep the airway 'clear', giving the false impression that the baby is going to find it difficult to breathe unless all the fluid and mucus is first sucked out of the way. There is almost no evidence that this is ever necessary. **Moreover, blind deep suction of the nose or mouth can stimulate the vagus nerve leading to bradycardia and laryngospasm.**

However, the upper airway of any baby who is born limp and hypotonic certainly needs to be maintained and secured in just the same way as the airway of any other unconscious patient. In an unconscious patient pharyngeal tone decreases even more than it does during sleep causing the upper airway to narrow or close. When such patients are laid on their back the tongue also falls back, further obstructing the airway. The three key ways to counter this are to:

1. hold the head in the neutral position and
2. support the chin or
3. push the jaw forward.



CHIN LIFT

JAW THRUST



Correct Size

An oro-pharyngeal airway may be of help, especially if the jaw is small or there is some other oro-facial abnormality. Choose an airway that reaches the angle of the jaw when the flange is under the nose, and make sure it passes over the tongue and does not merely push the tongue further back. Put the airway into the mouth in the way you want it to lie after insertion – do not turn it round during insertion as is generally done when using such an airway in an adult.



Although it is rare for debris to totally block the trachea such a problem should be suspected if a baby tries to breathe but remains cyanosed and bradycardic, with laboured breathing and marked inter-costal and/or sub-costal recession. This is one of the few situations where tracheal intubation can be life saving at birth.

Section 13 Resuscitation of the newly born

Meconium Attempts to aspirate meconium from the nose and mouth of the unborn baby while the head is still on the perineum does not prevent meconium aspiration syndrome and this practice is no longer recommended.

Attempts to remove meconium from the airways of vigorous babies after birth also fail to prevent this complication.

However, if babies are born through thick meconium and are unresponsive (or 'not vigorous') at birth, the oropharynx should be inspected and cleared of meconium. If intubation skills are available, the larynx and trachea should also be cleared.

What to do if the trachea seems blocked

Meconium seldom blocks the trachea, and elective intubation and direct tracheal 'toilet' at delivery does not seem to reduce the risk of a subsequent chemical pneumonitis. Thick particulate debris can, however, rarely cause tracheal obstruction. Greasy vernix, a lump of gelatinous postnasal mucus, a congealed blood clot, and thick particulate meconium, have all been found to cause laryngeal obstruction on occasion. Such debris is never going to be drawn up any standard suction catheter threaded into an endotracheal tube. The best that can be done is to insert an endotracheal tube as far into the trachea as possible, apply mechanical suction to the end of this tube, draw some of the material into the tube, and then remove the tube and blow it clear. Such a manoeuvre may need to be repeated 2-3 times. Luckily, experience suggests that such a problem will only be encountered once in every 5000 births at most.

Third Ensure the baby is Breathing B

If the baby is not breathing adequately by about 90 seconds **give 5 inflation breaths**. Until now the baby's lungs will have been filled with fluid. Aeration of the lungs in these circumstances is likely to require sustained application of pressures of about 30 cm of water for 2-3 sec – these are 'inflation breaths'.

If the heart rate was below 100 beats/min initially then it should rapidly increase. If the heart rate does increase then you can assume that you have successfully aerated the lungs. If the heart rate increases but the baby does not start breathing, then continue to provide regular breaths at a rate of about 30-40 min⁻¹ until the baby starts to breathe.

If the heart rate does not increase following inflation breaths then it is most likely that you have failed to aerate the lungs effectively.

Consider:

- o Is the baby's head and neck in the neutral position?
- o Do you need jaw thrust?
- o Do you need a longer inflation time – correct time is 2-3 sec inspiration?
- o Do you need a second person's help with the airway?
- o Is there an obstruction in the oropharynx (laryngoscope and suction under direct vision)?
- o What about an oropharyngeal (Guedel) airway?

Check progress before moving on

- If the heart rate has **not** risen about 100 beats per minute within 20 seconds of initial lung aeration something is wrong. **Never** move on until you are quite sure you have

Section 13 Resuscitation of the newly born

achieved objective A and B. To do so is quite futile - chest compression will never restore the circulation until the blood being massaged from the lung to the heart contains oxygen.

- Look and see if the chest moves each time you apply mask pressure. It is usually easier to judge success with your eyes than with a stethoscope.
- Go back and check that the baby's head is well positioned. Check chin support and jaw thrust. Ask a second person to help you position the baby optimally.
- Few babies need support with their breathing once their lungs have been aerated. Most will gasp, cry, or breathe just as soon as an attempt is made to get air into the lung and then continue breathing adequately.
- A few may, however, benefit from further support if they do not start to breathe regularly, or only gasp occasionally. Some may be limp and hypotonic, and a few may be drowsy because of drugs given to the pregnant woman or girl during labour. Check that the heart rate remains normal (above 100 beats per minute) and that there is no central cyanosis (best judged by looking at the colour of the tongue).
- If breathing is laboured, or irregular, or the baby's colour remains grey or blue, try and assess whether there is hypoxaemia with a pulse oximeter. The aspiration of liquor or meconium into the lung before birth can also render a baby oxygen dependent. Other possibilities include intrapartum pneumonia, diaphragmatic hernia, choanal stenosis, pneumothorax, and, more rarely, pulmonary hypoplasia (possibly associated with a skeletal or renal abnormality). Cyanotic congenital heart disease is another possibility, although this usually takes a little time to appear. Hypoxaemia can also be the first sign of persistent fetal circulation. You should be able to achieve a saturation of at least 95% when the baby is breathing 100% oxygen if there is no right-to-left shunt. Many babies continue to be given oxygen for a few minutes after birth when this is really not necessary. In contrast, many of the small number who really do need continuing supplemental oxygen are often only recognised to be in need of this when they have already become quite ill.
- If breathing does require continued support, try and reduce mask inflation pressures to little more than half of what was needed to aerate the lung in the first place. It is not difficult to over-ventilate a baby with healthy lungs and to wash out so much of the carbon dioxide that normally provides the main stimulus to breathing that all such activity stops for a while. There is also increasing evidence that sustained over-ventilation can seriously reduce cerebral blood flow.

Preterm babies

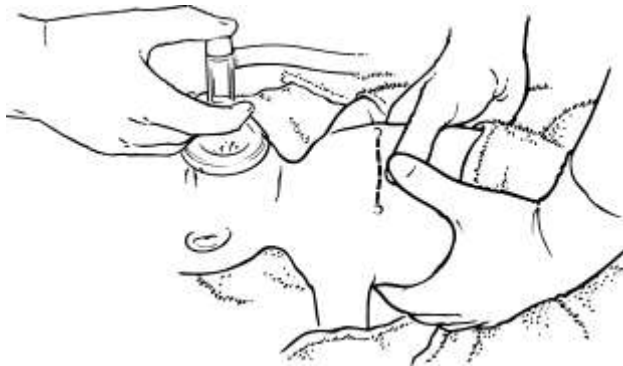
- Babies with surfactant deficiency may have difficulty in expanding their lungs, and in developing a normal 'cushion' of trapped lung gas (functional residual capacity, or FRC), at birth.
- The preterm lung is, however, quite a delicate structure with relatively little elastic support, and any use of undue pressure during resuscitation can initiate what later becomes a cascade of barotrauma.
- While an inspiratory pressure of 30 cm H₂O may well be necessary to aerate the lung at birth, such pressure is best not applied too abruptly, and should be reduced as rapidly as possible after that. The key aim must be to conserve such surfactant as already exists by sustaining the lung's functional residual capacity – an objective best achieved by providing at least 5 cm H₂O of positive end expiratory pressure (PEEP) consistently. Aim to achieve this, not only during initial stabilisation at delivery, but also during transfer to, and care in, the nursery. Where this can be achieved using nasal prongs or a nasal mask (nasal PEEP) it may be possible to avoid tracheal intubation altogether.

Fourth ensure Circulation C Chest compressions

- If the heart rate remains slow (less than 60/ min) or absent following 5 inflation breaths, despite good passive chest movement in response to your inflation efforts, start

Section 13 Resuscitation of the newly born
chest compression. Almost all babies needing help at birth will respond to successful lung inflation with an increase in heart rate followed quickly by normal breathing.

- Chest compression should be started only when you are sure that the lungs have been aerated successfully.
- In babies, the most efficient method of delivering chest compression is to grip the chest in both hands in such a way that the two thumbs can press on the lower third of the sternum, just below an imaginary line joining the nipples, with the fingers over the spine at the back.
- Compress the chest quickly and firmly, reducing the antero-posterior diameter of the chest by **about one third**.
- Because oxygenation is such an important part of neonatal resuscitation **the ratio of compressions to inflations in newborn resuscitation is 3:1**.
- Allow enough time during the relaxation phase of each compression cycle for the heart to refill with blood. Ensure that the chest is inflating with each breath.



Fifth Drugs D

Drugs are needed only if there is no significant cardiac output despite effective lung inflation and chest compression.

The drugs used are adrenaline (1:10,000), sodium bicarbonate (ideally 4.2%), and dextrose (10%). They are best delivered close to the heart, usually via an umbilical venous catheter. or, failing that, by direct cardiac puncture (only by those trained in this). Unfortunately, most of the babies in whom cardiac output only returns after treatment with bicarbonate do not survive to discharge, and most of those who do survive later develop profound disabling spastic quadriplegia.

Where the cause of the baby's terminal apnoea is a sudden, and much more abrupt, asphyxial event – such as shoulder dystocia or an occasional case of late cord prolapse – these reservations may be less valid. Here there is at least anecdotal evidence that the outlook, if the circulation can be restarted, is much less bleak.

- **Adrenaline:** The recommended dose for adrenaline is 10 microgram kg⁻¹ (0.1 ml/Kg of 1:10,000 solution). If this is not effective a dose of up to 30 microgram/ Kg (0.3 ml/Kg of 1:10,000 solution) may be tried. *A solution of 1 in 10,000 adrenaline should be made up and available in all delivery areas.* Do not use a higher dose by these routes as it is harmful.

Section 13 Resuscitation of the newly born

- **Sodium bicarbonate:** The dose for sodium bicarbonate is between 1 and 2 mmol /Kg (2 to 4 ml of 4.2% bicarbonate solution). **This has to be given intravenously; giving it into the trachea would cause a lethal chemical burn.** Indeed it really has to be delivered into the heart itself (either by direct puncture or through an umbilical catheter) to be effective when there is complete circulatory standstill.
- **Dextrose:** The dose of dextrose recommended is 200 mg/Kg (2 ml/Kg of 10% dextrose). Higher doses can lead to hyperglycaemia which is associated with cerebral oedema and cerebral haemorrhage. It is known that severe hypoglycaemia is rare immediately after birth, but tends to present after 1-2 days. However, **hypoglycaemia (less than 2.5 mmol/litre (45mg/dl))** is a potential problem for stressed or asphyxiated neonates, so its use should be considered in cardiac arrest, as the heart will not recover in the presence of hypoglycaemia. This should be followed by an infusion of 5ml/kg/hour of 10% dextrose, until feeding is well established. The **route** of administration is IV, but dextrose may also be given in the same dose via NG tube (10% solution) if the baby is not feeding well.
- **Naloxone** can be used to reverse profound opiate induced respiratory depression, but has no real role in neonatal resuscitation. If it does prove necessary, give it intramuscularly, and give a full 200 microgram 'depot' dose irrespective of body weight. If naloxone is given intravenously it is likely to be eliminated from the body six times as fast as the opioid drug causing the respiratory depression.
No other drug has ever shown itself to be of any use during neonatal resuscitation.

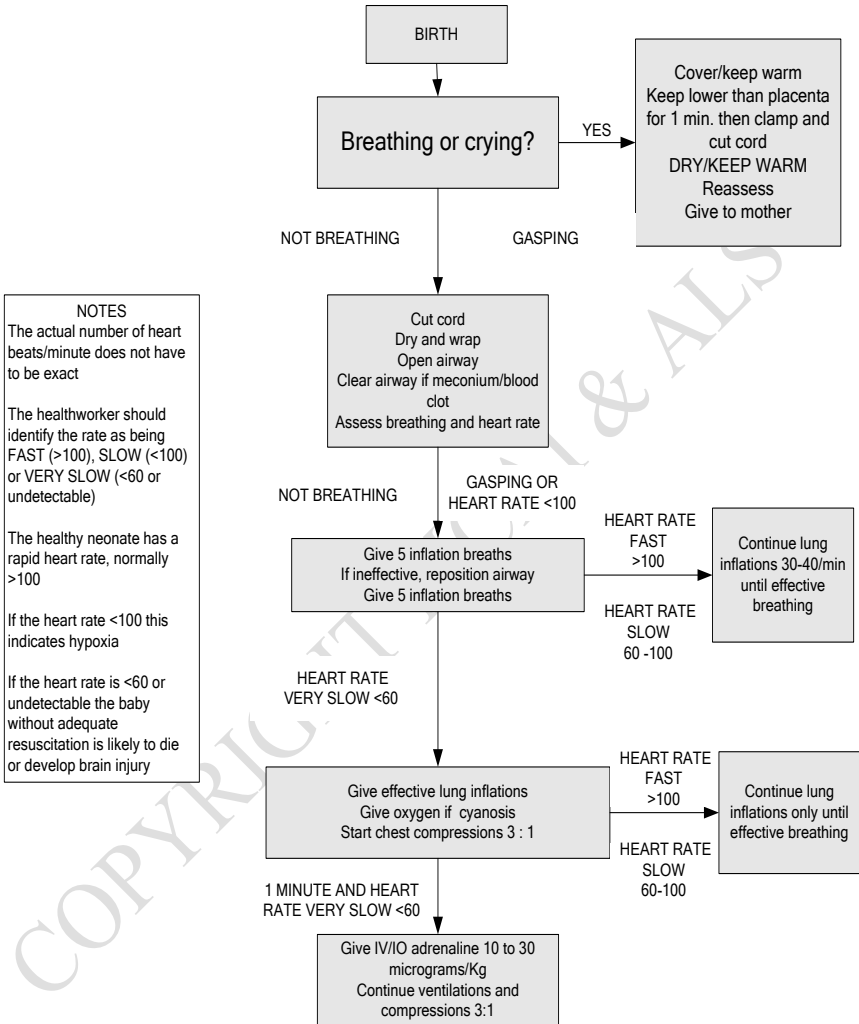
Acute blood loss as a cause of circulatory arrest (circulatory volume support)

Sudden acute blood loss is rare, but often unrecognised, cause of acute circulatory collapse. Bleeding from an aberrant placental blood vessel (*vasa praevia*) can rapidly lead to hypovolaemic death. The response to a rapid, generous, infusion of any intravenous fluid can be equally dramatic. Circulatory collapse probably does not occur until the baby has lost between 30 and 40 ml/kg of blood, but 20 ml/kg of Ringer-Lactate or Hartmann's will usually reverse the immediate critical hypovolaemia rapidly. The initial intravenous fluid bolus should be **10 ml/kg** of Ringer-Lactate or Hartmann's, and **this can be repeated ONCE** if there is no immediate response, or only minimal response. So can plasma albumin, or some artificial plasma expanding agent (such as gelatin). A packed red cell transfusion using group O Rh-negative blood can be given later to correct the associated anaemia.

Other, less well recognised, causes of hypovolaemic collapse include acute fetomaternal blood loss, sudden twin-to-twin transfusion, and accidental incision of the placenta during caesarean delivery. There are reports suggesting that placental abruption can also occasionally cause fetal blood loss. Partial cord occlusion can occasionally obstruct the umbilical vein while blood flow from the baby to the placenta remains uninterrupted causing acute unrecognised hypovolaemia. The resultant circulatory arrest and bradycardia does not respond to any of the maneuvers commonly used during resuscitation, but does respond promptly to volume replacement.

Aside from these specific indications 'volume' should not be used during neonatal resuscitation. There is no evidence to suggest benefit from this, and routine use only compounds the problem of fluid balance that can develop over the next 2-3 days if severe intrapartum stress causes secondary renal failure.

Newborn Resuscitation Algorithm



NOTES

The actual number of heart beats/minute does not have to be exact

The healthworker should identify the rate as being FAST (>100), SLOW (<100) or VERY SLOW (<60 or undetectable)

The healthy neonate has a rapid heart rate, normally >100

If the heart rate <100 this indicates hypoxia

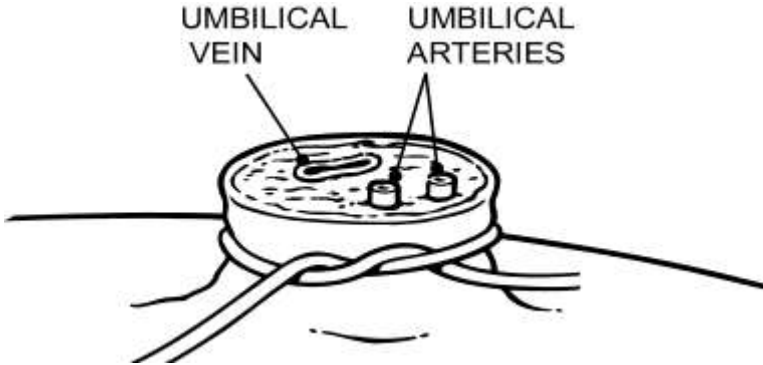
If the heart rate is <60 or undetectable the baby without adequate resuscitation is likely to die or develop brain injury

Section 13 Umbilical vein catheter

Umbilical vein catheterisation

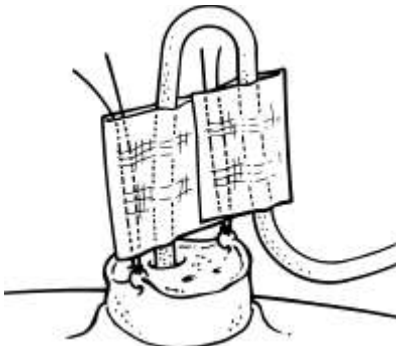
The only quick way of correcting hypovolaemia in a shocked baby at birth is to catheterise the umbilical vein. The essential steps are as follows –

- Place a loose cord ligature round the base of the cord (tightening and securing this later as necessary).
- Cut the cord about one cm from the skin in a single clean stroke using a sharp scalpel or a razor blade (a saw like action can leave the edge of the vein jagged and hard to



cannulate).

- Identify the three cord vessels. The thin-walled vein is usually in the upper right quadrant (towards the head end of the baby). The two stiff, white, contracted, bloodless arteries (which pass down the abdominal wall to join the iliac arteries) are usually in the two lower quadrants.
- Take an end-hole umbilical catheter and attach it, via a 3-way tap, to an empty 2 ml syringe.
- Take hold the edge of the vein with fine artery forceps and thread the catheter in far enough for blood to flow back easily. If you are able to advance the catheter 10 cm in a 3 kg baby the tip has probably just entered the right atrium (7cm is a more appropriate distance for a 1 kg baby). Never force the catheter if resistance is encountered in the first 2-3 cms. Ideally check position with Xray or ultrasound.
- Take a blood sample for haematocrit if possible, and then give any emergency drug or fluid as required.



Ensure that no air bubbles are present in the catheter by with drawing some blood. Then flush the catheter with saline or Ringer-Lactate or Hartmann's to maintain patency, and secure the catheter in place with two sutures and tape as shown.

The whole procedure should be done as cleanly as possible although, in a real emergency, there is no time to adopt a full aseptic technique.

Section 13 Umbilical vein catheter

- If you are on your own, the mother's needs come first – most babies are quite good at looking after themselves.

Poor response to resuscitation

If the baby either fails to respond, or makes a poor response to resuscitation, the most likely problem is inadequate oxygenation. The following steps should be taken:

- Check the airway and ventilation
- Check for technical faults if using equipment
 - Is the oxygen attached?
 - Is the airway blocked?
 - has the correct size of oropharyngeal airway been selected?
 - Is the endotracheal tube in the correct place?
- Re-examine the chest to see if a pneumothorax has developed – this is not uncommon, but seldom causes a problem. Drain a tension pneumothorax with a small cannula over needle (21 gauge) in the second intercostal space in the mid-clavicular line
- Consider the possibility of a congenital heart lesion if the baby remains cyanosed, despite breathing and a good heart rate
- Consider the possibility of maternal opiates or anti-hypertensive sedation such as diazepam or phenobarbitone if the baby is pink, well perfused, but requires assisted ventilation
- Severe anaemia, caused by blood loss, should respond to a rapid bolus of **10 to 20ml/kg of O-ve blood.**
- **Consider hypoglycaemia**

Stopping resuscitation

Even with the most effective resuscitation, not all babies will survive. The prognosis is poor if the baby has been without a cardiac output after 10 minutes of resuscitation. If the baby does not respond in spite of effective ventilations and chest compressions, the outcome is unlikely to be altered by use of drugs, although these should be considered. The decision to stop resuscitation should be taken by the most senior health worker present, and the reason for the decision should be clearly documented.

Documentation

It is important to keep accurate records of the steps taken during resuscitation, so that the reason for any decision is clearly documented, including the decision to start as well as end resuscitation. This is important, irrespective of the immediate outcome of the resuscitation effort. As with any documentation, keep to the facts and make a complete record of all the steps taken, their timings and the impact they had on the baby's progress. Remember to sign and date the record.

Vitamin K

Following resuscitation/stabilisation of the newborn ALL should receive 1mg Vitamin K intramuscularly (NOT INTRAVENOUSLY AS IM INJECTION PROVIDES A DEPOT OVER MANY WEEKS) to prevent possible haemorrhagic disease of the newborn.

Section 14 Common emergencies in the first month of life

MANY EMERGENCIES CAN BE PREVENTED BY ATTENTION TO INFECTION

PREVENTION, ADEQUATE WARMTH AND GOOD FEEDING PRACTICES.

DRUG USE IN THE NEWBORN BABY

All the products listed as capable of being given by intramuscular injection (IM) in this section can also be given intravenously (IV) unless otherwise stated. The IV route should always be considered if the baby is already being given IV glucose or glucose with saline or Ringer-Lactate or Hartmann's, because this can reduce the amount of pain to which the baby is subjected. There are dangers associated with rapid administration however, and breaking into an existing IV line can increase the risk of sepsis. Erecting an IV line merely to administer drugs also risks exposing the baby to a dangerous fluid overload unless a syringe pump can be used to control the rate at which fluid is infused.

BREATHING PROBLEMS

Breathing problems are particularly common in the period immediately after birth.

Features of respiratory distress in the newborn include

- Tachypnoea (rate > 60 /min),
- Recession of the chest wall and sternum
- Expiratory grunting
- Nasal flaring
- Prolonged apnoea
- Gaspings
- Tachycardia
- SaO₂ < 94% in air
- Cyanosis late presentation of a respiratory cause, may reflect cardiac cause

Causes of respiratory distress in the newborn

Common

- Lack of surfactant causing respiratory distress syndrome in the pre-term baby
- Infection acquired before or during delivery
- Transient tachypnoea of the newborn (wet lung)

Less common

- Meconium aspiration
- Persistent pulmonary hypertension of the newborn
- Pneumothorax

Rare

- Pulmonary hypoplasia
- Congenital abnormalities e.g. diaphragmatic hernia, choanal atresia, tracheo-oesophageal fistula
- Respiratory distress syndrome in the term baby
- Pulmonary haemorrhage

Non-respiratory

- Cardiac lesions
- Intra-cranial pathology
- Severe anaemia

Airway and Breathing

Babies should be offered enough supplemental oxygen to avert any suggestion of central cyanosis. Pulse oximetry offers an ideal way of assessing need and of rationalising use. It can be employed to assess initial disease severity, to monitor subsequent progress, and to ensure that such supplies of oxygen as are available are optimally used. Giving oxygen into a clear plastic hood (head box) placed over the head stops the oxygen supply from dropping every time a tent or incubator door is opened. A nasal catheter, or prongs, optimises the efficient use of the available supply. These devices also make it very much easier to move and handle the baby without disrupting that supply. However they make it rather more difficult to assess how much oxygen is needed to control cyanosis.

- Babies should always have their actual oxygen needs monitored at regular intervals. Measuring the inspired concentration needed to keep their oxygen saturation levels within the normal range (94-98%) is one of the best ways of measuring of the baby's changing condition.
- The level of SaO₂ that is optimal in the neonate continues to be the subject of debate. ESS-EMCH advises that SaO₂ be kept between 94% and 96% in babies cared for at sea level.
- Keep the baby warm, and keep handling to a minimum. Where it can be afforded, the semi-continuous use of a pulse oximeter makes it possible to leave the baby clothed, to minimise handling, and to dispense with any other monitoring of pulse and respiration.
- Try to humidify the air the baby is breathing if the oxygen content needs to rise much above 40% (since piped and cylinder supplies of oxygen are very dry).
- Babies with serious respiratory distress should not be offered milk (or anything else by mouth) until their condition has stabilised and a probable cause for the distress has been established. Support expression of breast milk in the mother so that she is ready when her baby has recovered to provide breast milk.
- Babies less than 2-3 days old, and older babies who look fluid depleted, should always be started on an hourly IV infusion of 5 ml/kg/hour of 10% dextrose (or, for babies more than 3 days old, of 10% dextrose with 0.18 % sodium chloride). 5ml/Kg per hour of 10% glucose is the minimum amount of glucose (equivalent to 8mg/Kg/minute of glucose) needed to avoid hypoglycaemia in a baby who is not receiving any enteral glucose. Higher concentrations than 10% are sclerosing to veins and there is good evidence that the newborn can easily excrete 120ml/Kg/day. NOTE: 5ml/Kg per hour corresponds to 5 drops/minute in a "standard infusion giving set" in a 3Kg infant and 3.5 drops per minute in a 2Kg infant. Ideally use an infusion set with a micro-dropper (where 1ml = 60 micro-drops). A standard infusion set gives 20 drops/ml and can lead to dangerous fluid overload if not carefully controlled. Older babies who seem relatively stable and only moderately ill can be offered small quantities of milk through a fine oro-gastric feeding tube.
- Give antibiotics, at least for the first 48 hours, if bacterial infection could be the reason for the baby's respiratory distress (either IM, or IV if there is an IV line in place). Take blood for culture first wherever possible.
- Take a chest x-ray where facilities allow.

Specific management issues: Primary surfactant deficiency ('RDS')

The principles of treating RDS are

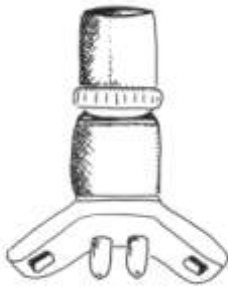
- Minimal handling of the baby
- Supplementary oxygen
- IV fluids
- No oral feeding

Section 14 Emergencies in the neonatal period: breathing problems

- Increased end expiratory pressure
- Avoid hypothermia

Surfactant deficiency is by far the commonest cause of respiratory distress in the preterm baby in the first three days of life. Luckily it is a self-limiting condition, because birth always triggers an immediate increase in surfactant production. The challenge is, therefore, to support the baby for the first two days of life without doing further damage to the lung until such time as the deficiency resolves itself.

- The key features of RDS (cyanosis, an expiratory 'grunt', tachypnoea, and intercostal and/or sub costal recession) all become clinically obvious within four hours of birth.
- Treatment is supplemental oxygen, minimal handling, IV fluid and 'nil by mouth'
- The expiratory grunt which is a characteristic feature of this condition is the baby's own method of sustaining positive end expiratory pressure (PEEP), and holding the alveoli open. Making the baby breathe against a constant positive airway pressure (CPAP) gradient achieves the same thing and, by applying this pressure at the nose (nasal CPAP), the complications associated with tracheal intubation can be avoided.
- To be maximally effective we now know that CPAP should be applied from birth, just as soon as the lung has first been aerated. Paired short prongs or specially made nasal mask are probably best because they minimise airway resistance.



Even the 3mm nasal cannulae normally used to provide supplemental oxygen have some effect.

However pressures of 5 to 8 cm H₂O really require the use of a purpose made device. There are several to choose from. All that is then required is a controlled flow of blended, humidified, air and oxygen, and a simple device for producing controlled adjustable back pressure. Regular nursing attention is necessary to make sure that the device remains correctly positioned and does not cause necrotic pressure damage to the nose, but this is a skill that does not take long to acquire.

Transient tachypnoea of the newborn This is almost indistinguishable from RDS at birth. Unlike RDS however, the symptoms do not become more marked with time in the hours after birth. Most of these babies are born at, or near, term, all are tachypnoeic, and a few are overtly cyanosed for a 6-12 hours after birth. The condition seems to be caused by some poorly defined difficulty with lung aeration and pulmonary adaptation at birth. All these babies will recover on their own as long as handling is kept to a minimum and as long as they are not fed until their symptoms have subsided. Some need supplemental oxygen, but few need it for more than 24 hours.

Section 14 Emergencies in the neonatal period: breathing problems

Aspiration pneumonia Aspiration of particulate matter can occasionally almost block the trachea. It can also, more commonly, cause a chemical pneumonitis. Meconium can be particularly irritant in this regard, making the term baby very oxygen dependent for the best part of a week. It may also trigger a persistent fetal circulation (see below). Nevertheless with minimal handling, IV fluid and generous supplemental oxygen, most of these babies can be expected to make a complete recovery as long as there has been no associated anoxic cerebral damage. Providing unnecessary respiratory support may actually make matters worse by increasing the risk of pneumothorax. Antibiotics should probably be given until it is clear there is no associated bacterial infection.

Aspiration after birth can also cause a similar picture. Milk can block the trachea but it seldom causes much of an inflammatory reaction. Gastric acid can be much more damaging. Recurrent minor unrecognised reflux and aspiration is probably commoner than a single massive episode of aspiration and it can certainly, over time, render the baby quite oxygen dependent. Babies who are hypotonic, or have a poor cough reflex, are at particular.

Bacterial pneumonia This should be managed as outlined in the section on suspected infection, remembering that there may be septicaemia as well as pneumonia.

Persistent fetal circulation

This is an uncommon, but potentially life threatening, condition caused by poor lung perfusion after birth. It may complicate birth asphyxia, meconium aspiration, early bacterial pneumonia, diaphragmatic hernia, RDS or – very occasionally – be a primary disorder.

After birth the pressures in the pulmonary vessels remains high, so that the normal fall in pressure in the right atrium, right ventricle and pulmonary arteries, does not occur. As a result of this, the blood flows through the fetal circulation (the foramen ovale and ductus arteriosus), from the right side of the heart, to the left. This blood has not been oxygenated, so the baby soon becomes cyanosed. It is difficult to differentiate this from a congenital cardiac malformation. Serious cyanosis in a baby with a well aerated lung on chest x-ray and progressive acidosis can cause rapid self-perpetuating cyclical deterioration.

- The treatment in the first instance is oxygenation, minimal handling, IV fluids and avoidance of oral feeds.
- Survival is only likely however, once a well established problem has developed, in a unit capable of providing sustained respiratory support.

Pneumothorax This is present more frequently than expected, and may occur spontaneously in up to 2% of babies. It is often asymptomatic, and may be associated with meconium aspiration and respiratory distress syndrome. It does not automatically need to be treated, unless it causes progressive respiratory distress. Emergency treatment is by thoracocentesis followed by the insertion of a chest drain into the 4th or 5th intercostal space in the mid to anterior axillary line.

Congenital malformation The commonest congenital defect causing respiratory distress soon after birth is diaphragmatic hernia. This occurs in 1:4000 births and more commonly affects the left side. Clinical examination reveals reduced air entry on the affected side, and a displaced apex beat. The chest x-ray is diagnostic. An IV line should be erected in the interim, the gut kept as empty of gas as possible, and food withheld. Restricted lung growth means that only about half these babies have any chance of survival.

Management of diaphragmatic hernia

- oxygen supplements,

Section 14 Emergencies in the neonatal period: breathing problems

- minimal handling,
- IV fluids and withholding of oral feeds
- NGT to keep the stomach empty
- Stabilisation of respiration
- Transfer to surgical care if responds to treatment

Congenital heart disease occasionally causes overt cyanosis from birth, but there are seldom any associated signs of respiratory distress.

Recurrent apnoea

- Irregular, and periodic, breathing is common in the preterm baby and often becomes more of a problem after the first few days of life before then becoming less common again. It usually stops being an issue at least 3-4 weeks before the baby was due to be born. Pre-term babies may suffer episodes of hypoxaemia with or without absent ventilation (apnoea). Sometimes recurrent apnoea is associated with gastric reflux, particularly in neurologically compromised babies with poor airway protective reflexes.
- Exclude sepsis and/or seizures.
- Monitoring is needed if the baby becomes bradycardic and cyanosed - the best monitoring device is a pulse oximeter.
 - Gentle stimulation is usually all that is required to start the baby breathing again.
- Bag-Valve-Mask resuscitation can occasionally be called for, and there should always be equipment to hand so that this is not delayed should it be necessary.
- Oral caffeine, if available, will nearly always reduce the number of episodes in the preterm baby, and caffeine seldom causes the tachycardia and the other side effects sometimes seen with theophylline. **Caffeine citrate** Give a 20 mg/kg loading dose by mouth, followed by 5 mg/kg once every 24 hours. No commercial formulation is generally available, but an oral solution is not difficult to prepare.
- Stubborn recurrent apnoea occasionally requires management with a period of nasal CPAP.
- Sometimes a sudden cluster of apnoeic episodes can be an indication of early sepsis in a previous well baby.

NEONATAL SEPSIS

Babies are very prone to infection and can become ill very rapidly once infection takes hold. Antibiotic treatment is only likely to work if started early, but the recognition of early infection is not easy.

Signs associated with infection in the neonate

- Child feeding less than well than before
- Child lying quiet and making few spontaneous movements
- Deep body temperature more than 38°C
- Capillary refill time > 3 seconds
- Respiratory rate 60 or more breaths a minute
- Indrawing of the lower chest wall when breathing, *or* grunting
- Cyanosis
- History of a convulsion

All such babies deserve immediate admission and careful review. Suspect bacterial septicaemia with or without early meningitis and treat—

- Secure the **airway** and ensure the baby is **breathing adequately**
- Give high flow **oxygen until stable**
- Insert an IV cannula, using full sterile precautions. Umbilical vein catheterisation may be the easiest way to gain vascular access quickly in a shocked baby less than a week old. Otherwise it might be necessary to site an **intra-osseous** line or cannulate a **scalp vein**. Take a sample of blood for culture if available and for blood glucose and other biochemical tests if available. Failure to sterilise the skin rigorously can render blood culture results uninterpretable.
- Give 2 ml/kg of 10% glucose IV over 2–3 minutes, followed by a first dose of ampicillin and gentamicin (or chloramphenicol). If the baby becomes more alert and active then you know that hypoglycaemia was probably one of the baby's problems, even before the laboratory report. Continue 10% glucose infusion until the baby is well enough to be fed orally.
- If IV access is not immediately possible give initial antibiotic dose IM. **Never wait for the results of cultures or microscopy before starting antibiotics.**
- Start an hourly IV infusion of 5 ml/kg of 10% dextrose (or 10% dextrose in 0.18% sodium chloride after 3 days) wherever possible in any baby who is shocked, dazed or drowsy, and in any baby less than a week old.
- If the baby is shocked, give an IV bolus of 10ml/kg of Ringer-Lactate or Hartmann's
- If the baby has any respiratory symptoms take a chest x-ray if facilities allow.
- Look regularly to see if cyanosis is developing and give supplemental oxygen using a nasal catheter or prongs or a head box. Most of the babies who become infected during delivery develop respiratory symptoms and progressive signs of septic shock within a few hours of birth. Do not give anything by mouth to a baby who is breathless, especially if there is additional evidence of oxygen dependency, until symptoms have stabilised.
- If there are any features suggestive of meningitis get a lumbar puncture done within 2 hours of starting antibiotic treatment because the blood culture is sterile in 15% of babies with early meningitis. **Do not delay antibiotic therapy for a lumbar puncture.**

Section 14 Emergencies in the neonatal period: NEONATAL SEPSIS

- Microscopic examination of the CSF (meningitis = 20 or more cells/mm³) can provide early confirmation of meningitis, but a differential white blood cell count does not help with the decision to initiate or continue antibiotic treatment.
- Urinary tract infection can cause a Gram negative septicaemia. Check a clean catch or supra-pubic urine sample for infection (primarily by microscopy). Identification of a urine infection may suggest imaging of the renal tract and prophylactic antibiotics.
- **Watch for, prevent and correct any sign of, hypothermia.**
- Antibiotics can be stopped after 48 hours if the blood cultures are negative and the baby has improved. If blood cultures are not available, continue the antibiotics for the full course appropriate for the site of infection (meningitis 10-14 days).

Drugs used for severe infection in the neonate

- **Ampicillin (or amoxicillin)** Give 100 mg/kg per dose IV where meningitis is a possibility. Give 50 mg/kg per dose in other situations. Give one dose every 12 hours in the first week of life, every 8 hours in a baby 1–3 weeks old, and every 6 hours in a baby older than that. Oral dosing can sometimes be used to complete a course of treatment.
- **Benzylpenicillin** Give 60 mg/kg if meningitis, or tetanus is a possibility. The same high dose should be given if congenital syphilis is compounded by CNS involvement. Give 30 mg/kg per dose in all other situations. Time the interval between each dose as for ampicillin. Oral dosing (with phenoxymethylpenicillin) can sometimes be used to complete a course of treatment.
- **Cefotaxime** Give 50 mg/kg per dose IV or IM. Time the interval between each dose as for ampicillin except in meningitis where doses are given 6 hourly.
- **Ceftriaxone** Give 50 mg/kg once a day IV or IM. A single dose will suffice when treating gonococcal conjunctivitis.
- **Chloramphenicol** This remains a useful antibiotic, although there is a serious risk of death from liver failure if the dose suggested here is exceeded. Give a 25 mg/kg loading dose IM followed by 12 mg/kg once every 12 hours to babies less than 1 week old. Give this dose every 8 hours in babies 1–4 weeks old unless there is evidence of liver damage or renal failure. Babies older than this can be given 25 mg/kg once every 8 hours from the outset. Oral dosing can be used to complete any course of treatment.
- **Cloxacillin (or flucloxacillin)** Give 100 mg/kg per dose IM or IV if meningitis or osteitis is a possibility. Give 50 mg/kg per dose in other situations. Time the interval between each dose as for ampicillin. Oral treatment can often be given to complete a course of treatment.
- **Erythromycin** Give 12.5 mg/kg per dose by mouth once every 6 hours. There is no satisfactory IM Preparation.
- **Eye drops (and ointments)** Prophylactic 1% silver nitrate drops have been used to minimise the risk of gonococcal infection (IM ceftriaxone being used for overt infection). The use of 2.5% polyvidone-iodine solution may be equally effective. 1% tetracycline ointment should be used (with oral erythromycin) to treat chlamydia conjunctivitis - a condition that is not prevented by silver nitrate use. *Pseudomonas* infection requires treatment with systemic and topical gentamicin (0.3% eye drops).
- **Gentamicin** Give 5 mg/kg IM or IV once every 24 hours. If baby weighs less than 2Kg give 4mg/Kg per dose. Leave 36 or 48 hours between each dose if there is renal failure.
- **Metronidazole** Give a 15 mg/kg loading dose and 7.5 mg/kg per dose once every 12 hours in babies less than 4 weeks old and every 8 hours in children older than that. Treatment can be given IV or my mouth, but solubility makes IM use unsatisfactory.
- **Miconazole** This controls infection with *Candida* ('thrush') better than topical nystatin. Use the oral gel at least four times a day and the skin cream twice a day for at least 7 days. Topical treatment with 0.5% aqueous gentian violet for not more than 4 days may be

Section 14 Emergencies in the neonatal period: NEONATAL SEPSIS

equally effective. Oral nystatin drops (1 ml four times a day) can be used to reduce heavy intestinal tract carriage.

- **Nevirapine** Give the pregnant woman or girl a 200 mg oral dose in labour. Then give the baby one 2 mg/kg dose by mouth 2 days later to minimise foeto-maternal transmission of HIV infection. It is not easy to get clear evidence to show that this is worth doing where the pregnant woman or girl had already started taking zidovudine at least 4 weeks before delivery. Advice on breast feeding has to be individualised when the mother has HIV.
- **Procaine penicillin** Give asymptomatic babies born to mothers with evidence of untreated syphilis a single 100 mg/kg IM injection. **Never** give this drug IV. Babies thought to be infected at birth are often given 100 mg/kg once a day for 10 days, but repeated IM injections can cause a sterile abscess with subsequent muscle fibrosis and atrophy, and treatment with IM or IV benzylpenicillin for 10 days (as specified above) is just as effective. Babies born to mothers fully treated for syphilis (1.8 grams (2.4 megaunits) of benzathine benzylpenicillin at least 4 weeks before birth need no further treatment after birth.
- **Zidovudine** Babies born to mothers taking zidovudine during pregnancy should be given 2 mg/kg once every six hours for 6 weeks after delivery. In babies born more than 6 weeks early this dose should only be given once every 12 hours for the first 2–4 weeks. Advice on breast feeding has to be individualised when the mother has HIV.

SEVERE JAUNDICE

All babies become progressively more jaundiced for a few days after birth. The serum

Age	PHOTOTHERAPY		EXCHANGE TRANSFUSION	
	Healthy newborns > or = 35 weeks Gestation	Newborns < 35 weeks gestation or any risk factors	Healthy newborns > or = 35 weeks gestation	Newborns < 35 weeks gestation or any risk factors
Day 1	Any visible jaundice		260 mmol/L (15 mg/dL)	220 mmol/L (10 mg/dL)
Day 2	260 mmol/L (15 mg/dL)	170 mmol/L (10 mg/dL)	425 mmol/L (25 mg/dL)	260 mmol/L (15 mg/dL)
Day3+	310 mmol/L (18 mg/dL)	250 mmol/L (15 mg/dL)	425 mmol/L (25 mg/dL)	340 mmol/L (20 mg/dL)

bilirubin level usually peaks at between 100 and 300 µmol/l 3–5 days after birth (Figure), but this peak may be higher.

There is in this situation an increasing risk that bilirubin will breach the blood/brain barrier causing critical damage to many cells in the brain’s basal nuclei if, in the presence of haemolysis, the unconjugated serum bilirubin level is allowed to rise much above 350 µmol/l. Indeed, in a small preterm baby who is also ill, the safe limit may be nearer to 250 µmol/l).

Regular early and frequent enteral feeding, by increasing bilirubin elimination through the gut, can make such a problem less likely.

Haemolysis

Term babies should seldom need treatment with phototherapy unless there is an unusually high rate of red cell breakdown. However, phototherapy should be started just as soon as jaundice becomes apparent if there is evidence of haemolytic disease. The trend in the bilirubin level should then be checked twice a day (the level can not be judged from skin colour once phototherapy has been started).

Section 14 Emergencies in the neonatal period: JAUNDICE

Most importantly: clinically noticeable jaundice within 24 hours of birth (or any level above the dashed line in figure), especially if the mother is blood group O and the baby is group A or group B, or the mother is rhesus negative and the baby is rhesus positive.

These factors below suggest a risk for haemolysis.

- Red cell antibodies in the mother's blood.
- A positive Coombs or direct anti-globulin test in blood from the umbilical cord.
- A family history of G6PD deficiency or congenital spherocytosis.
- A history that previous children were seriously jaundiced in the first week of life.
- Otherwise unexplained neonatal anaemia at birth (a haemoglobin level <130 g/l or a haematocrit < 40%).

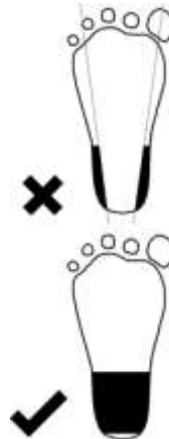
Causes of abnormally raised bilirubin

- Haemolytic disease
- Neonatal sepsis
- Breast milk jaundice
- Hypothyroidism
- Congenital infection
 - Toxoplasmosis
 - Cytomegalovirus
 - Rubella
 - Hepatitis

Causes of Physiological Jaundice in the Neonate

- Increased breakdown of red blood cells in the first few days of life
- Reduced life span of red cells (70 days compared with 120 in the adult)
- Less efficient metabolism of bilirubin by the immature liver

Only a small amount of blood is needed to check the bilirubin. Although described as a heel prick, sticking a needle into the heel runs a high risk of entering the underlying bone, and can lead to osteomyelitis, so should be avoided. It is safe to take blood from any part of the back third of the foot.



Try and use a 2.4 mm blood lance, but never use the same lance on more than one baby because of the risk of transmitting hepatitis or HIV infection. It is not necessary or appropriate to try and sterilise the skin first as long as it is clean, and the use of anesthetic cream does nothing to reduce the response of the baby to the pain inflicted. The baby will also show fewer signs of distress if held, or given something to suck, during the procedure. Grip the heel firmly enough to make it go red, but not white, stab the heel just once, and then squeeze gently and intermittently to stimulate blood flow. The use of a standard lance should optimise blood collection because it helps to ensure that the skin is punctured to a

Section 14 Emergencies in the neonatal period: JAUNDICE

standard depth. Slight finger pressure on the site for about a minute is usually enough to stop any further bleeding after the procedure is over.

Exchange transfusion

Exchange transfusion is generally only undertaken if the rate of red cell breakdown is likely to exceed the ability of phototherapy to control levels of bilirubin. However this is very likely to occur in babies with a positive Coombs test who are already anaemic (because of fetal haemolysis) at birth, and a cord blood haemoglobin of less than 130 g/l serves to identify most of these babies.

Function of exchange transfusion

- Removal of maternal antibodies
- Removal of antibody coated red blood cells before they haemolyse
- Corrects anaemia
- Lowers total bilirubin, if sufficient time for equilibration between intravascular and extravascular levels

Exchange Transfusion

1. Calculate the baby's circulating volume = 80 ml/kg. Twice this amount of blood will be required. Do not exceed this (usually <1 bag of blood = 450ml) Do not use blood > 4 days old
2. Check that the blood is compatible with the mother's serum and the same ABO group as the baby. If the exchange is for severe anaemia, use packed red cells if possible
3. Ensure the baby is closely monitored throughout the procedure
4. This is a sterile procedure, so gloves and gowns must be used and universal precautions applied
5. Secure umbilical vein access
6. Ideally, use a blood warmer (especially for low birth weight infants) otherwise warm by placing under mother's dress next to skin
7. Set up a closed circuit with either a 4-way tap, or two 3-way taps. The four links are
 - a. The baby
 - b. The syringe for removing and replacing blood
 - c. The blood to be transfused
 - d. The route for discarding the baby's blood
8. Make sure that the total blood in and out is recorded. Plan to spend 1.5 to 2 hours on the procedure
9. Withdraw 6 mls of blood from the baby and discard it
10. Withdraw 6 mls of blood from the blood bag or bottle and transfuse into the baby

Steps 9 and 10 should in total take about 3 minutes to avoid abrupt changes in BP

11. Repeat steps 9 and 10 until the correct volume of blood has been exchanged.
12. Symptomatic hypocalcaemia may occur as the citrate in donor blood binds calcium. This responds best to halting the procedure for 15 minutes. Giving calcium gluconate is of little benefit and may be hazardous, so is best avoided.

Exchange transfusion should only be undertaken once all the attendant risks have been considered. Even in experienced hands 1% of babies may suffer a sudden circulatory

Section 14 Emergencies in the neonatal period: JAUNDICE

arrest during or shortly after the procedure. This should respond to prompt intervention using the approach adopted when dealing with circulatory standstill at birth but the baby needs to be monitored closely, and staffs need to be ready for such a possibility if this is not to prove fatal. Air embolism can kill within minutes, and faulty technique can cause sudden hypo- or hypervolaemia, or introduce later sepsis. The use of donor blood more than five days old can cause serious hyperkalaemia and an arrhythmia. Blood straight from the fridge at 4°C can impose a major cold stress.

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FITS, SPASMS AND COMA

Causes of neonatal fits

- Hypoxia
- Hypoglycaemia
- Meningitis
- Drug related seizures
- Sepsis
- Tetanus
- Hypocalcaemia
- Hyper or hypo natraemia
- Metabolic abnormalities
- Developmental disorders
- Benign neonatal seizures

If the baby is alert and well between episodes of seizure activity, seems normal on examination, and is feeding normally, it may be perfectly appropriate to do nothing. In **benign neonatal sleep myoclonus**, jerky movements that spare the face only occur when the baby is going to (or waking from) sleep. No treatment is required and the problem disappears before the baby is a year old.

Benign neonatal seizures, which are sometimes familial, can also be managed without drug treatment, and resolve within a few days or weeks.

Focal seizures can also be the sign of what was otherwise a silent haemorrhagic infarction of part of the brain.

Well but jittery baby

No abnormal eye movements
No apnoea
No colour changes
No heart rate changes
Easily triggered by handling and stopped by gentle passive flexion of the affected limb
Rhythmical movements

Baby with clonic seizures

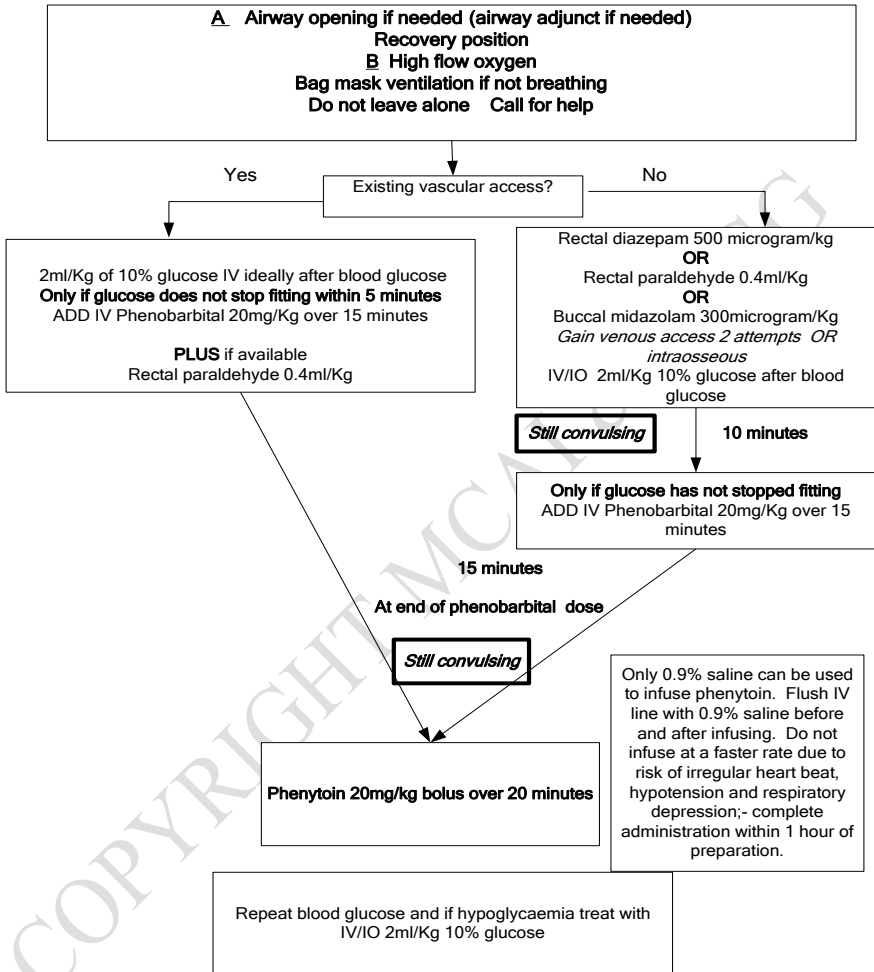
Abnormal eye movements
Apnoea
Pallor or cyanosis
Tachycardia
Independent of handling
Jerky with fast and slow components that are not equal

Management of the fitting neonate

- Airway and Breathing
- Circulatory access
- Give glucose IV or NG (2ml/Kg of 10% glucose)
- Give antibiotics IV or IM
- Stop fit with anticonvulsant:
 - Phenobarbitone 20mg/Kg over 5 minutes IV or IM
 - Paraldehyde 0.2ml/Kg IM or 0.4ml/Kg rectally

Achieve **vascular access** if possible

Pathway of Care Prolonged Fitting in neonates



NOTES

Indications: Still fitting when seen OR If already in hospital where onset of fit is seen and generalised convulsion lasting > 10-15 minutes or repeated convulsions without return of consciousness between fits.

Hypoglycaemia is blood glucose <2.5 mmol/l (45mg/dl) if well nourished and < 3.0mmol/l (55mg/dl) if severe malnutrition

If blood glucose cannot be measured treat as hypoglycaemia.

Section 14 Emergencies in the neonatal period: FITS SPASMS AND COMA TETANUS
If hypoglycaemia has been present give feed (milk or sugar water) orally or NG when conscious. To make an oral or NG sugar solution dissolve 4 level teaspoons of sugar (20 gram) in 200ml of clean water.
If IV/IO glucose does stop fitting, repeat blood glucose 30 minutes later.

If there is any concern that the baby is not otherwise entirely well it is essential to rule out the **three main treatable causes of fitting (hypoglycaemia, meningitis and tetanus)** since any delay in diagnosis could be serious.

- **1. Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) Always think of this**

Erect an IV line, using sterile precautions and take a sample of blood for blood culture and for biochemical tests (if available). Then give 2 ml/kg of 10% dextrose over 2–3 minutes. If the baby almost immediately becomes more alert it is then important to keep the blood sugar level stable by starting a sustained infusion of 5 ml/kg of 10% dextrose per hour for the next 2-4 days while gradually building up oral feeds.

- Fits due to hypoglycaemia typically start in a previously well baby on the second day of life. Although laboratory estimates of blood glucose are ideal for diagnosing and managing this condition reagent strips can be helpful.

2. Meningitis Always try to recognize this. Start treatment as soon as the diagnosis is suspected. Ampicillin and gentamicin (see the neonatal formulary) is the most frequently used combination where the organism remains uncertain. Benzylpenicillin may be preferable for known group B streptococcal infection. Cefotaxime is the drug of choice for most Gram negative organisms (with ceftazidime for *Pseudomonas* infection). Neither cefotaxime nor ceftazidime should be used on its own if *Listeria* infection is a possibility. It is important to attempt lumbar puncture once the baby has been stabilised, and ideally within 2 hours of initiating antibiotic treatment, because this serves to confirm the diagnosis. Lumbar puncture is also more likely than blood culture to identify the organism responsible, and to identify it quickly.

3. Tetanus

Do not forget tetanus. Neonatal tetanus has to be considered if a previously well and still conscious infant starts to develop increasingly frequent muscle spasms 3–14 days after birth. This becomes more relevant if there is any doubt about the way the umbilical cord was managed at birth or if there is no proof that the mother was ever immunised with tetanus toxoid vaccine. Involuntary muscle contractions are typically triggered by quite light touch or sound and the hands and jaw are often held firmly clenched.

- **Airway and Breathing** are frequently compromised. Secure and maintain the airway, ensure adequacy of ventilation. *Oxygen* may help if the spasms are causing cyanosis, but in severe cases survival may be dependent on the availability of *respiratory support* sometimes with *tracheostomy* to protect the airway. Intubation may trigger very dangerous spasm of the airway and must be undertaken by a skilled person.
- Insert an **intravenous line** for drug and antibiotic administration.
- Give high dose *benzyl penicillin* 60 mg/kg IV one dose every 12 hours in the first week of life, every 8 hours in a infant 1–3 weeks old, and every 6 hours in a infant >3 weeks old age. Oral dosing (with *phenoxy methylpenicillin*) can sometimes be used to complete a course of treatment.
- Give a 150 unit/kg dose of IM human tetanus immunoglobulin, and 0.5 ml of IM tetanus toxoid vaccine into a different limb. **Other IM injections must be avoided at all costs, since they will provoke spasms.**

Section 14 Emergencies in the neonatal period: FITS SPASMS AND COMA TETANUS

- If the infant/child is in **acute spasm**, this should be terminated by giving **diazepam by bolus IV infusion over 15 minutes (dose 200 micrograms/kg) or rectally (400 micrograms/kg)**. Ensure that for intravenous infusion, diazepam is diluted to 100 micrograms/ml and that extravasation does not occur (very irritant). Slow and incomplete absorption means that IM Diazepam is not effective. .
- Also give an **IV loading dose of 25-40mg/Kg of magnesium sulphate** over 20-30 minutes
- Subsequently give IV diazepam 200 micrograms/Kg every 4-6 hours and magnesium sulphate 10-20mg/Kg 2-4 hourly IV to control spasms.
- Stop diazepam if magnesium alone controls the spasms.
- Reduce the dose of diazepam if apnoeic episodes occur.
- **ALWAYS HAVE A BAG MASK AVAILABLE IN CASE THE PATIENT STOPS BREATHING AS A RESULT OF THE DIAZEPAM PLUS MAGNESIUM.**
- When stable, a nasogastric tube, ideally passed by an anaesthetist, will allow fluids, food and drugs to be given with minimal disturbance. Feeds need to be given frequently (ideally hourly) and in small amounts due to reduced gut motility. **Regular breast milk feeds via a nasogastric tube are essential.**
- In neonatal tetanus, wide excision of the umbilical stump is not indicated.
- Finally the disease itself does not induce immunity, so after recovery tetanus vaccine must be given for future prevention.
- *Treat any obvious umbilical infection* with an additional broad-spectrum antibiotic.
- *Minimise handling in a quiet, dark room* and give frequent small tube feeds.
- *Immunising the mother* (two 0.5 mL doses a month apart) will prevent a similar tragedy in any future pregnancy.
- *May need muscle paralysis and ventilation*

Treatment of neonatal tetanus

- Airway and Breathing: Oxygen as needed and tracheostomy may be required
- Benzyl penicillin
- Tetanus toxoid vaccine into different limb
- Consider diazepam IV or PR to control spasms
- Magnesium sulphate has been recently shown to help prevent spasms in tetanus
- Minimise handling
- Frequent small tube feeds

Rule out any biochemical cause

Remember the biochemical disturbance may not be the main underlying problem In many babies with evidence of hypoglycaemia or hypocalcaemia, the biochemical disturbance is only one symptom of another more serious illness. Of these by far the most important treatable condition is meningitis. Unless the baby is otherwise well it is important not to miss this possibility.

- Other important diagnostic possibilities include hypocalcaemia, hyponatraemia and hypernatraemia. Other clinical features will help in the recognition of hypo- and hypernatraemia, and a serum sodium level clinches the diagnosis. Any existing problem will be made worse if hypernatraemia is corrected too rapidly.
- Fits due to hypocalcaemia (a serum calcium of < 1.7 mmol/l), with or without hypomagnesaemia, are generally benign and occur unexpectedly in an otherwise well but

Section 14 Emergencies in the neonatal period: FITS SPASMS AND COMA TETANUS hyper-reflexic baby more than 2-3 days old. As with hypoglycaemia symptoms may settle if the baby is given 2 ml/kg of 10% calcium gluconate as a *slow* IV infusion, but such seizures usually respond to oral supplementation. They are not a serious cause for concern, but it is appropriate to investigate the mother for an unrecognised endocrine abnormality if facilities allow. **DO NOT ALLOW IV CALCIUM TO GO OUTSIDE THE VEIN AS IT WILL CAUSE SEVERE TISSUE DAMAGE.**

Kernicterus Babies with brain damage due to jaundice are stiff and stuporose, but seldom have fits. Symptoms usually appear quite abruptly 3-6 days after birth, but by the time they appear it is too late to initiate treatment.

Inborn errors of metabolism Other more complex biochemical disturbances are usually associated with metabolic acidosis and progressively deepening coma in a baby who was initially well for 1-2 days after birth. They are generally too complex to treat without substantial biochemical support, but it may be appropriate to take specimens for later diagnostic evaluation because many of these conditions are familial and genetically determined. Pyridoxine deficiency is one of the few rare treatable conditions. **Other problems arising during delivery** Once bacterial meningitis has been excluded intrapartum asphyxia or birth trauma will be the underlying problem in most other babies presenting with fits in the first 2-3 days of life. Most of these babies look unwell within a few hours of birth. The onset may be a little more sudden and abrupt in the preterm baby who suffers a sudden intraventricular haemorrhage. These babies usually become progressively more stuporose and unresponsive over time, and there is relatively little that can be done to improve the long term outlook. An attempt should be made to minimise hypoxia, and anticonvulsant treatment is sometimes initiated in the hope that it will reduce the number of apnoeic episodes. Many are too ill to accept even tube feeds and, where this is the case, it may be appropriate to minimise the risk of hypoglycaemia by giving IV glucose. Where there is any possible suggestion of a generalised bleeding tendency give 1 mg of IM vitamin K (unless this was given at birth).

The outlook is fairly bleak for babies who have not recovered and started to feed normally within a week of birth.

Drug related seizures Accidental infiltration of the fetal scalp during the injection of lidocaine into the maternal perineum can cause fits simulating intrapartum asphyxia but, with supportive treatment, there is every prospect of complete recovery. Some babies born to drug-dependent mothers show symptoms of drug withdrawal 1-2 days after delivery and a small minority have seizures.

Developmental disorders It is said that up to 10% of otherwise unexplained neonatal seizures are associated with the existence of some underlying cerebral problem. Some of these children will benefit from continuing anticonvulsant treatment.

Anticonvulsant treatment

Treatment with phenobarbital will often control neonatal seizures although it is doubtful whether it often has any major influence on the long term outcome.

Adding phenytoin increases the success rate. In cases where such anticonvulsant treatment is effective it can usually be stopped after 7-10 days.

Paraldehyde can be an extremely effective short term measure. While large IM injections can cause a painful sterile abscess, this is not a problem when the volume does not exceed 1 ml. Also consider the rectal route which can be equally effective

Section 14 Emergencies in the neonatal period: FITS SPASMS AND COMA TETANUS

Phenobarbital Give a 20 mg/kg loading dose followed by 4 mg/kg once every 24 hours.

Treatment can be given IV, IM or by mouth. Seizure control may be achieved more quickly if the first dose is given IV, but this loading dose must be given slowly, over at least 5 minutes, to minimise the risk of shock, hypotension or laryngospasm. Some recommend the use of a higher dose if the standard dose fails, but this can cause respiratory depression.

Phenytoin Initial seizure control with this drug requires the presence of a saline filled IV line (because the drug crystallizes in dextrose solutions). The same problem also renders the IM route unavailable. Give a 20 mg/kg loading dose IV slowly over 10-20 minutes (to avoid cardiac arrhythmia) and then 2 mg/kg IV or by mouth once every 8 hours. Babies more than 2-3 weeks old may need a considerably larger maintenance dose.

Paraldehyde Give 0.2 ml/kg by *deep* IM injection. This dose can be repeated once if seizures persist. Give within 10 minutes when using a plastic syringe (because paraldehyde interacts with many plastics). It can also be given as a single 0.4 ml/kg dose mixed with an equal volume of mineral oil into the rectum.

VOMITING AND BOWEL PROBLEMS

- **Ingested liquor / blood** - Babies who have swallowed a lot of liquor, or blood, before birth mayretch and appear distressed after birth, particularly if the liquor contained meconium. Such problems almost always settle within a few hours without any intervention
- **Oesophageal atresia** – should always be considered in the baby with excess frothy saliva. Surgery is much more likely to be successful if this can be performed before aspiration pneumonia develops. Pass a large bore catheter as far down the oesophagus as possible. If an x-ray shows that this has stopped at the level of the heart and has not entered the stomach the diagnosis is made. Such a baby needs referral for surgery and steps taken to suck the blind upper oesophageal pouch clear of all accumulating secretions at least once an hour before and during transfer. Site an IV line and ensure the baby does not become hypoglycaemic
- **Uncoordinated feeding** - Babies born before 36 weeks gestation often have difficulty sucking and swallowing in a coordinated way. Most will initially need some tube feeds. They are not likely to start gaining weight until they are taking at least 120 ml/kg of milk a day, and they need to be fed regularly at least once every 4 hours day and night.
- **Regurgitation** - Hurried feeding may cause regurgitation and, if the cough reflex is poorly developed, this can cause the baby to inhale milk into the lung. This will cause a chemical pneumonitis – which could progress to bacterial pneumonia, and make the baby increasingly oxygen dependent. Newborn babies benefit, therefore, from frequent small feeds every 2-3 hours. Dehydration (and the risk of hypoglycaemia) need to be prevented during this period by giving supplemental 10% dextrose IV so that total fluid intake (taking the IV and the oral intake together) does not fall below 120 ml/kg per day.
- **Respiratory distress** – A small proportion of babies show signs of respiratory distress during the first 2-3 days of life because lung surfactant production is limited. Such babies should not be offered anything by mouth until these problems settle. Peristaltic activity is also reduced or absent in babies who are shocked, ill or infected, so these too should not be offered anything by mouth. The passage of stool, a renewed interest in sucking, and return of bowel sounds suggests that the paralytic ileus has resolved, and oral feeding can be re-introduced.
- **Feeding tubes** - Orogastric feeding is the best option for babies who have not yet developed a coordinated suck and swallow reflex. Nasogastric tubes can block one nostril, significantly increasing the work of breathing. Preterm babies nearly always accept a large orogastric feeding tube without showing any sign of distress. In this situation, therefore, it is often better to pass a wide-bore oral tube each time, test for any 'gastric residual', syringe the feed slowly in over about five minutes, and then withdraw the tube again in one steady movement. The tube can then be washed out, left in weak sodium hypochlorite,

Section 14 Emergencies in the neonatal period: VOMITING AND BOWEL PROBLEMS and reused for the same baby indefinitely. Small frail babies should be handled as little and gently as possible and can be left lying undisturbed in their cots during a tube feed as long as the head end of the cot is elevated 25 cm.

- **Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl))**

If drowsy, unconscious or convulsing, check blood glucose.

If glucose <1.1 mmol/l (<20 mg/100 ml), give glucose IV.

If glucose 1.1–2.2 mmol/l (20–40 mg/100 ml), feed immediately and increase feeding frequency.

If you cannot check blood glucose quickly, assume hypoglycaemia and give glucose IV. If you cannot insert an IV drip, give expressed breast milk or glucose through a nasogastric tube.

- **Change in feeding habit - A sudden reluctance** to feed is one of the commonest early signs of bacterial infection. Babies who are becoming drowsy also show no interest in feeding.

Vomiting – Persisting **minor reflux** is seldom a problem even if it makes the baby go temporarily apnoeic. Such reflux in a small baby often responds to smaller more frequent feeds.

Serious vomiting, often associated with abdominal distension, in the first few days of life suggests the existence of a problem requiring referral for surgical review. This is particularly true if the vomit is green or bile stained as this is suggestive of duodenal atresia and requires urgent surgical intervention. If serious vomiting develops in a baby who has passed changing stool, the diagnoses of **volvulus, pyloric stenosis or intussusception** must be considered, so surgical evaluation is essential.

Necrotising enterocolitis – Preterm or light for dates babies are at increased risk of developing this condition, as are those with underlying cardiac abnormalities.

Suspect the condition in a baby who had started accepting oral feeds, and then develops an ileus or becomes lethargic and starts passing a bloody stool. The problem is caused by the sudden focal invasion of bacteria into an area of ischaemic gut, and an abdominal x-ray will often show gas accumulating within the gut wall. Treat as for suspected sepsis and, because the gut wall has often been invaded by anaerobic Gram negative organisms, give metronidazole as well. Feeds should be discontinued for at least 5 days. Measure haemoglobin daily and transfuse if it falls below 8g/dl (haematocrit below 24%).

Immediate mortality is quite high, but many cases resolve without surgical intervention (although a stricture may occasionally develop later in the affected area of gut), and it is usually possible to reintroduce feeds after ~5 days. A baby who is sucking and showing interest in food is usually ready for feeding. Intestinal perforation is generally the main indication for surgical intervention, but the prognosis really depends on whether there is generalised peritonitis, and on whether some part of the gut has become totally dead and gangrenous.

SECTION 15 Management of Paediatric Emergencies

Recognition of the seriously ill child

The outcome following cardiac arrest is poor for children. Early recognition and treatment of children presenting with problems affecting respiratory, cardiovascular and CNS function reduces mortality and morbidity.

The primary assessment ensures that problems with the greatest threat to well being are treated first. The priority is assessment and management of

<p>A – airway B – breathing C – circulation D – disability – which covers conditions affecting the CNS</p>
--

To be able to evaluate the child, you must be aware of the normal respiratory and heart rates of children at different ages

WHO definitions tachycardia: > 160 bpm aged under 1 year and >120 bpm aged 1 to 5 years.

WHO definitions for raised respiratory rates in the child are:

< 2 months fast breathing is > or = 60/minute

2months to 11 months fast breathing is > or = 50/minute

1 to 5 years fast breathing is > or = 40/minute.

Primary Assessment of the Airway

If the child is crying or able to talk, then they have a patent airway. The degree of patency can be assessed by

Look

- obvious obstruction to upper airway
- chest and abdominal movements
- drooling of saliva
- posture adopted – e.g. is the neck extended to maximise the airway opening.

Listen

- Noises - coughing or choking sounds
- Stridor which suggests an upper airway obstruction
- Air entry

Feel – air movement

<p>If any concerns regarding patency of the airway, use the opening airway techniques and re-assess. Proceed along the lines of basic life support and airway maintenance.</p>

Primary Assessment of Breathing

It is important to check

- Effort of breathing – how hard is the child having to work to breathe; and is the child becoming exhausted
- Efficacy of breathing – is the effort being put in resulting in good air entry and oxygenation
- Effects of inadequate breathing – looking for signs that in spite of the effort being put in, the child is not being adequately oxygenated

Section 15 Paediatric emergencies: recognition of the seriously ill child

Effort of breathing

Be aware of the exhausted child who may show signs of little respiratory effort, but be seriously unwell. Apparent reduction in effort should be accompanied by improvement in the child's condition. If it is not, the child is getting worse, and getting tired. Children with CNS depression and those with neuromuscular problems may not have increased effort of breathing – this does not mean they are recovering.

Respiratory rate

- Too fast suggests either lung / airway disease, or a metabolic acidosis
- Too slow suggests fatigue or raised intra-cranial pressure

Recession

- More common in younger children, and suggests a serious problem if noted in a child over the age of 6-7 years
- Look for intercostal, subcostal and sternal recession
- The degree of recession is a useful indicator of the severity of the problem

Inspiratory / expiratory noises

- Stridor is usually inspiratory and suggests upper airway narrowing
- Severe obstruction might cause expiratory stridor
- Wheeze is usually expiratory and associated with lower airway disease
- In neither stridor nor wheeze is the volume of noise an indicator of the severity of the condition

Grunting

- This means the child is trying to breathe out against a partially closed larynx, to prevent collapse of small airways at the end of expiration
- It is usually heard in infants with stiff lungs and is a sign of severe respiratory distress

Use of accessory muscles

- Head bobbing in infants is an attempt to use the sternocleidomastoid muscles to increase air entry.
- flaring of the nostrils increases the calibre of the nasal airway in infants
- neck extension helps keep the airway straight as to allow ease of air entry
- splinting of the pectoral girdle assists when there is increased stiffness of the lungs

Efficacy of breathing

look chest movements

listen bilateral air entry

a silent chest is a very serious sign

pulse oximetry

useful in almost all cases

unreliable in severe anaemia, shock or carboxyhaemoglobinaemia

Effects of inadequate respiration on other organ systems

Heart rate

- hypoxia leads to tachycardia
- fever, pain and anxiety also cause tachycardia, so this is a non-specific sign.
- Measuring trends in heart rate is useful
- severe hypoxia leads to slowing of the heart rate – this is a very serious sign and can rapidly progress to cardio-respiratory arrest if the hypoxaemia is not effectively treated.

Skin colour

- Hypoxia causes pallor.
- Cyanosis is a late sign and may not be detectable in an anaemic child. Unless chronic and associated with congenital heart disease, it represents a serious life threatening problem that needs urgent treatment.

Section 15 Paediatric emergencies: recognition of the seriously ill child

Central nervous system

- Hypoxia and/or hypercapnia cause agitation and drowsiness
- The change in mental status is difficult to detect in infants
- Failure to interact or recognise parents is a serious sign
- Check AVPU

If there are problems with breathing, provide a high flow of oxygen. It may be necessary to help with ventilation.

Primary Assessment of Circulation

It is important to check

- Cardiovascular status
- Effects of circulatory inadequacy on other organs

Cardiovascular status

Heart rate

- Initially increases in shock as the body tries to maintain cardiac output with a falling stroke volume
- Be sure to be familiar with normal heart rates (above)

Pulse volume

- The quality of the pulse may be helpful; the absence of peripheral pulses and weak central pulses is a sign of serious cardiovascular problems

Capillary refill

- This is measured by pressing over the sternum, or non-dependant periphery, for 5 seconds and then releasing. Normal capillary refill is ≤ 3 seconds
- It is less reliable when the child is cold
- Although not a sensitive or specific sign of shock, it is a useful measure which, taken with other signs, may help in evaluating the response to resuscitation

Blood pressure

- **Systolic BP = 80 + (age in years x 2)**
- Always use the correct sized cuff – the length should be 2/3 the length of the upper arm, and the bladder should go round at least 40% of the arm – but not overlap.
- BP may be maintained despite a loss of up to 50% of the circulating blood volume so is a **late sign which if not treated urgently may progress to cardio-respiratory arrest.**
- Monitoring trends in BP and changes in pulse pressure is useful.

Effects of circulatory inadequacy on other organ systems

Respiratory system

Tachypnoea and hyperventilation occur in response to metabolic acidosis when the child tries to increase the rate of oxygenation of the blood being circulated.

Skin

Pale, mottled skin indicates under perfusion

Central nervous system

Altered mental status indicates an under-perfused brain

Urine output

< 2ml/kg/hr in infants and < 1ml/kg/hr in the older child indicates under perfusion of the kidneys.

If there are signs of SHOCK, consider giving a fluid bolus of 10-20ml/kg of Ringer-Lactate or Hartmann's

Section 15 Paediatric emergencies: recognition of the seriously ill child

Primary assessment of disability

Once a respiratory or cardiac cause of altered level of consciousness has been ruled out, it is important to consider the CNS causes. In order to function properly the brain needs

- adequate perfusion with adequately oxygenated blood and this may be compromised by respiratory or cardiovascular inadequacy (as above) or by raised intracranial pressure, causing reduced cerebral perfusion pressure
 - intracranial pressure may be raised by
 - increased brain volume e.g. infection, oedema, trauma or tumour
 - increased CSF e.g. outflow obstruction
 - increased volume of blood e.g. trauma, hypercapnia
- glucose- hypoglycaemia (**less than 2.5 mmol/litre (45mg/dl)**) is an important cause of impaired consciousness in children.

CNS function may be compromised by convulsions, drugs, and CNS infections

CNS compromise presents with neurological deficit, and effects the respiratory and cardiovascular systems

Neurological assessment

Conscious level

- A rapid assessment of conscious level can be made by using the AVPU scoring system

A	ALERT
V	responds to VOICE
P	responds to PAIN
U	UNRESPONSIVE

- Pain should be elicited by sternal pressure or by pulling the frontal hair. A child who **only** responds to pain has a Glasgow Coma score of ≤ 8

Posture

- Many children who are seriously unwell have a degree of hypotonia – particularly infants
- Decerebrate or decorticate postures are ominous signs and may need to be elicited by use of a painful stimulus

Pupils

- Note pupil size, equality and reactivity
- The most important signs are inequality, dilation and unreactivity to light which indicate serious brain disorder
- Many drugs have an impact on the pupils and their effects are symmetrical

Respiratory effects of CNS failure

- Raised intracranial pressure or drugs may cause
 - Hyperventilation
 - Irregular respiratory patterns (Cheynes Stokes) – suggestive of a mid or hind brain problem

Section 15 Paediatric emergencies: breathing difficulties

- Slow, sighing respiration
- Apnoea

Cardiovascular effects of CNS failure

- Hypertension and bradycardia (Cushing's response) are indicative of a life-threatening rise in intracranial pressure and represent the brain's efforts to increase cerebral perfusion pressure
- The same signs appear with pressure on the medulla oblongata caused by herniation of the brain through the foramen magnum. This is associated with altered pupillary signs and is a **late sign which if not treated will lead to cardio-respiratory arrest.**

If there is a problem with the CNS, make sure the airway, breathing and circulation problems have been corrected. Always check blood glucose and correct if it is low

The Infant or Child with Serious Breathing Difficulties

Once the initial assessment has been completed, attention must be focused on managing the most likely cause of the breathing difficulty.

When dealing with a child with respiratory problems, always perform the primary assessment and manage problems as they arise.

A – always support and protect the airway

B --provide high flow oxygen; assist ventilation if needed

C – give IV fluids if signs of circulatory failure

Whatever the cause of the breathing difficulty, it is important to act when there are signs that the child is getting worse. Some important signs to look for are below

- Increasing recession
- Increasing respiratory rate
- Decreasing respiratory rate in a child who is not improving
- Apnoeic episodes
- Increasing pulse rate or bradycardia
- Fatigue or exhaustion
- Altered mental state
- Cyanosis

Section 15 Paediatric emergencies: breathing difficulties

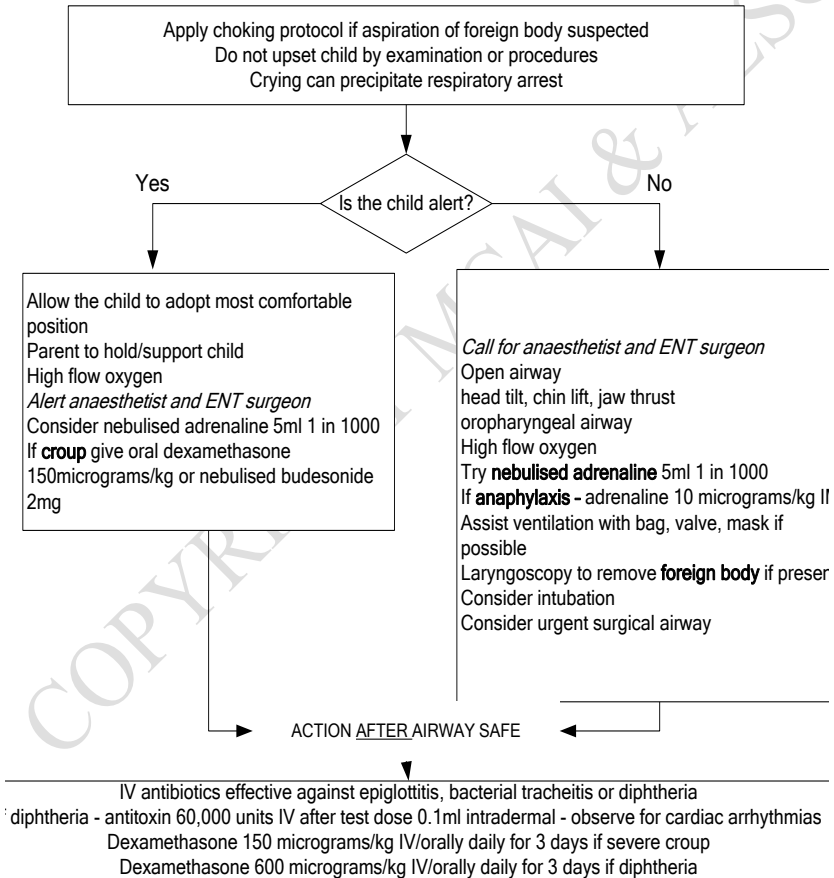
Table – Range of problems that cause breathing difficulties

Breathing difficulties	Causes
Upper airway obstruction	<ul style="list-style-type: none">• Diphtheria• Anaphylaxis• Croup• Foreign body• Epiglottitis• Retro-pharyngeal abscess• Anatomical causes
Lower airway obstruction	<ul style="list-style-type: none">• Tracheitis• Asthma• Bronchiolitis
Disorders affecting lungs	<ul style="list-style-type: none">• Pneumonia• Pulmonary oedema
Disorders around the lungs	<ul style="list-style-type: none">• Pneumothorax• Empyema• Rib fractures
Disorders of the respiratory muscles	<ul style="list-style-type: none">• Neuromuscular
Disorders below the diaphragm	<ul style="list-style-type: none">• Peritonitis• Abdominal distension
Increased respiratory drive	<ul style="list-style-type: none">• Diabetic ketoacidosis• Shock• Poisoning (eg salicylates)• Anxiety attack• Hyperventilation
Increased respiratory drive	<ul style="list-style-type: none">• Diabetic ketoacidosis• Shock• Poisoning (eg salicylates)• Anxiety attack• Hyperventilation
Decreased respiratory drive	<ul style="list-style-type: none">• Coma• Convulsions• Raised intracranial pressure• Poisoning

Upper airway obstruction

This is potentially life threatening and may be caused by swelling, secretions or foreign material. The smaller the child the more at risk they are because of the small cross sectional area of the airways.

Pathway of Care: Acute Upper Airway Obstruction in Children



Croup Croup is usually caused by a virus. As with any condition which affects the airway, the patient will be frightened. Do not do anything to make this worse. Do not put anything in the child's mouth, or cause pain by repeated attempts at cannulation.

Clinical Features

- Child age 6months – 5 years
- 1 – 3 days coryza
- mild fever < 38.5
- barking cough or hoarseness, worse at night
- inspiratory stridor
- variable respiratory distress
- usually resolve without need for admission

Treatment of Croup

- Oxygen if SaO₂ < 95%
 - In severe cases nebulised adrenaline 5ml 1:1000
 - Dexamethasone 0.6 mg/kg PO or IM or equivalent dose of other steroid**
- Or
- Budesonide 2mg nebulised
 - If concerned re bacterial tracheitis treat with antibiotics (e.g. cefuroxime)
 - Intubation may be needed in severe cases

** 1mg prednisilone = 5mg hydrocortisone = 0.15mg dexamethasone

Epiglottitis This is almost always caused by *Haemophilus Influenzae type B* and is very rare in children who have been immunized. Some of the features are similar to croup, but the child is more unwell; the onset is more rapid and cough is not a feature

Comparison of Croup and Epiglottitis		
Feature	Croup	Epiglottitis
Onset	Over a few days	Over a few hours
Preceding coryza	Yes	No
Cough	Severe, barking	Absent or slight
Able to drink	Yes	No
Drooling saliva	No	Yes
Appearance	Unwell	Toxic, very unwell
Fever	< 38.5	> 38.5
Stridor	Harsh, rasping	Soft
Voice	Hoarse	Muffled, soft voice
Need for intubation	≈ 1%	> 80%

Treatment of Epiglottitis

Calm, reassurance. Do not distress the child

Elective intubation is the best treatment but may be very difficult – consider the need for surgical airway

IV antibiotics only when airway is safe– ceftriaxone or cefotaxime 30mg/kg

Measles

Measles is a highly contagious viral disease with serious complications (such as blindness in children with pre-existing vitamin A deficiency) and high mortality. It is rare in infants under 3 months of age.

Diagnosis

- Fever plus a generalized maculopapular rash and one of the following—cough, runny nose, or red eyes. In children with HIV infection, these signs may not be present and the diagnosis of measles may be difficult.

Life threatening complications

-
- Pneumonia
- Diarrhea: treat dehydration, bloody diarrhea or persistent diarrhea
- Measles croup: WHO say do not give steroids: EMCH as with other causes of croup give one dose of steroids
- Eye problems. Conjunctivitis and corneal and retinal damage may occur due to infection, vitamin A deficiency, or harmful local remedies. In addition to giving vitamin A (as above), treat any infection that is present. If there is a clear watery discharge, no treatment is needed. If there is pus discharge, clean the eyes using cotton wool boiled in water, or a clean cloth dipped in clean water. Apply tetracycline eye ointment, 3 times a day for 7 days. Never use steroid ointment. Use a protective eye pad to prevent other infections. If there is no improvement, refer to an eye specialist.
- Mouth ulcers. If the child is able to drink and eat, clean the mouth with clean, salted water (a pinch of salt in a cup of water) at least 4 times a day.
 - Apply 0.25% gentian violet to the sores in the mouth after cleaning.
 - If the mouth ulcers are severe and/or smelly, give IM/IV benzylpenicillin (50,000 units/kg every 6 hours (50mg/kg) and oral metronidazole (7.5 mg/kg 3 times a day) for 5 days.
 - If the mouth sores result in decreased intake of food or fluids, the child may require feeding via a nasogastric tube.
- Neurological complications. Convulsions, excessive sleepiness, drowsiness or coma may be a symptom of encephalitis or severe dehydration.

Severe complicated measles

The above plus:

- inability to drink or breastfeed
- vomits everything

Section 15 Paediatric emergencies: upper airway obstruction

- convulsions

On examination, look for signs of late complications after the rash has disappeared, such as:

- lethargy or unconsciousness
- corneal clouding
- deep or extensive mouth ulcers.
- pneumonia
- dehydration from diarrhea
- stridor due to measles croup
- severe malnutrition.

Treatment of severe measles

Children with severe complicated measles require treatment in hospital

Vitamin A therapy. Give oral vitamin A **to all** children with measles unless the child has already had adequate vitamin A treatment for this illness as an outpatient. Give oral vitamin A 50 000 IU (for a child aged <6 months), 100 000 IU (6–11 months) or 200 000 IU (12 months up to 5 years). If the child shows any eye signs of vitamin A deficiency or is severely malnourished, a third dose must be given 2–4 weeks after the second dose.

If the temperature is ≥ 39 °C (≥ 102.2 °F) and this is causing the child distress, give paracetamol.

Nutritional support

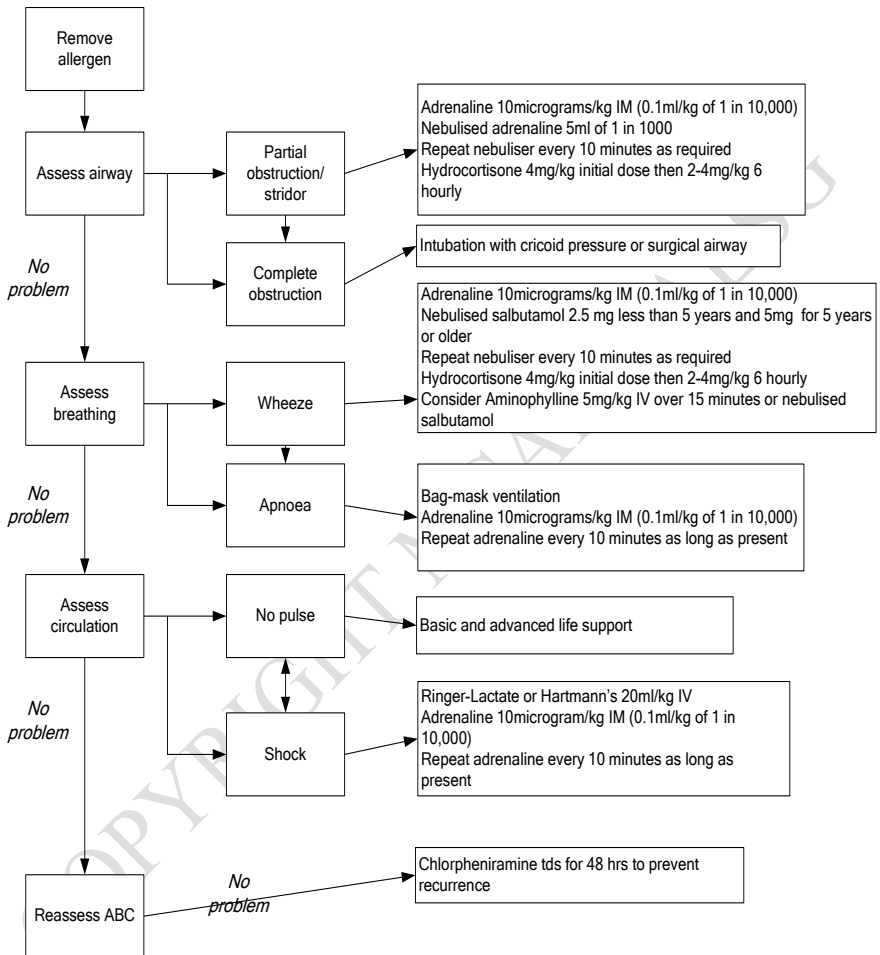
Anaphylaxis

This is a severe allergic reaction, which may cause respiratory or circulatory problems – or both. The main treatments are IM adrenaline 10micrograms/kg (only given IV / IO if severe shock or cardiac arrest) steroids and IV fluids

Diagnosis

Allergic reaction with respiratory difficulty and / or shock

Section 15 Paediatric emergencies: anaphylaxis
Pathway of care for Anaphylaxis in a child

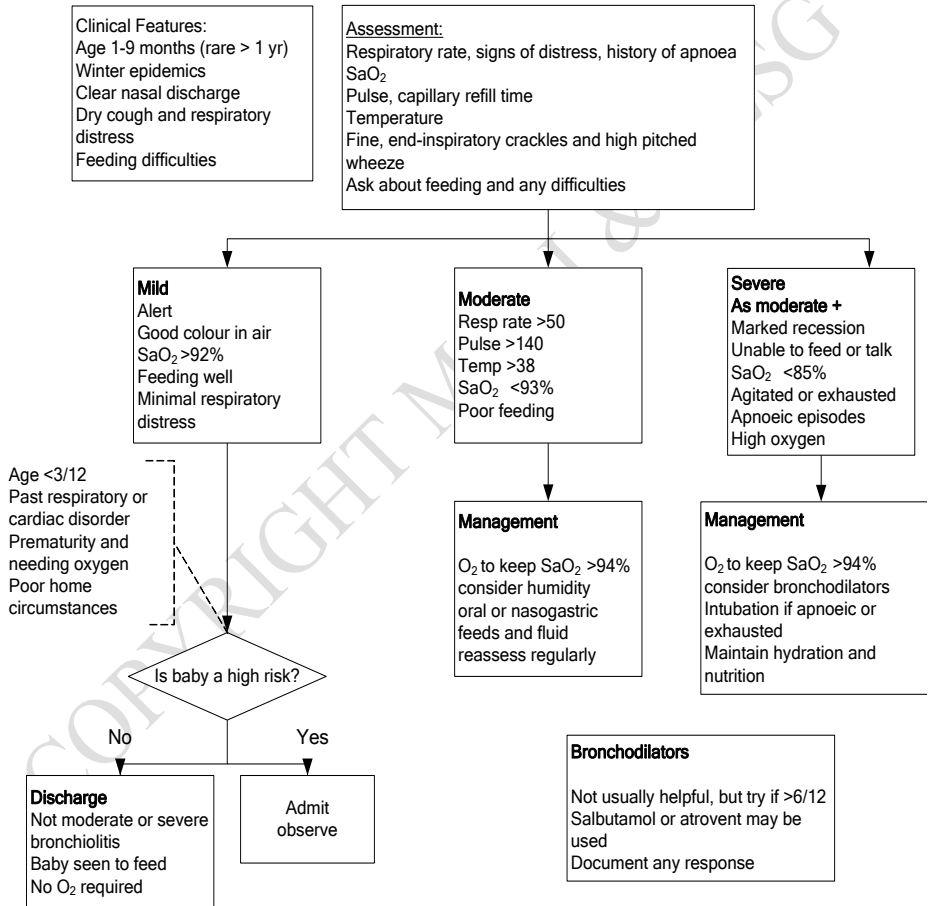


Section 15 Paediatric emergencies: bronchiolitis

Lower Respiratory Tract infections

Wheeze – The commonest diagnosis is either Bronchiolitis – in children under 1 year old or Asthma – in older children

Pathway of care for Bronchiolitis



Give antibiotics in severe cases of bronchiolitis

Asthma

The classic features of acute asthma are cough, wheeze and breathlessness. Any increase in these symptoms, difficulty walking, talking or sleeping, suggests the asthma is getting worse. Worsening asthma is often caused by a viral infection in young children, and by exercise in older children.

Assessment of severity

When trying to decide how severe an attack is, it is helpful to know how often the child has attacks; how severe they are (e.g. has the child ever been intubated); and what treatment is usually given. The clinical examination helps to decide if the child has moderate or severe/life threatening asthma

Management

- Avoid allergic/irritant factors, for example smoke, chemical fumes, house dust mites, animal fur. Discourage cigarette smoking and new pets at home.
- Do not stop child from exercising, but pre-dose 5-10 minutes beforehand with a dose of inhaled beta-2 agonist bronchodilators (for example salbutamol or terbutaline).
- Occasional symptoms (for example on 2-4 days per week) may be relieved with a bronchodilator (a reliever).
- Use inhaled where possible, apart from in acute severe or life-threatening attacks when the intravenous route may be used.
- Use an aerosol spray (metered dose inhaler) with a spacer (first choice):
 - (i) A commercial medium to large volume spacer, for example Volumatic, Aerochamber, or a large (2 litre) plastic bottle with the aerosol sealed into one end, and the open end held closely over the nose and mouth. (see Figure)
 - (ii) Use 200-1000 micrograms of salbutamol (2-10 sprays) or : more may be needed in younger children, or if acutely breathless (and repeated)
 - (iii) Each spray/puff should be inhaled individually in turn with 4-5 breaths, rather than filling the spacer device with multiple sprays
 - (iv) For children < 5 years old, attach a facemask (for example inverted adult mask) to the mouthpiece of a spacer

Clean spacer with soapy water and leave to dry naturally to reduce static electrical charges on inside.

- Alternatively use a nebuliser to deliver salbutamol (less portable).

Children with asthma should always have immediate availability to their usual reliever inhaler device: over 7-8 year olds may keep their device with them.

More frequent symptoms, regular nocturnal symptoms or daily use of a bronchodilator should be treated with regular medication aimed to control airway inflammation (preventer), such as inhaled steroids. Use inhaled, preferably through a spacer (first choice)

- eg beclometasone propionate or budesonide: 200-400 micrograms twice daily

Section 15 Paediatric emergencies: severe asthma

- rinse mouth after each dose of inhaled steroid
- aim for rapid control of symptoms, and then tail down dose over months
- gaining control may be helped by a short course (7-10 days) of systemic steroid (for example prednisolone 500 micrograms/kg once daily after food or milk, maximum daily dose 40 mg)
- continue with bronchodilator use for symptom relief (avoid regular use)

For regular or severe symptoms, consider:

- if diagnosis is correct
 - aggravating factors, for example rhinitis, stress, gastro-oesophageal reflux
 - medication is being taken and taken correctly
 - increasing inhaled steroid dose (beclomethasone to 400-800 micrograms twice daily) or
- or
- oral methylxanthines (for example theophylline 5 mg/kg 3-4 times a day)
 - **as a last resort**, use of alternate-day oral prednisolone (start at 500 micrograms/kg on alternate days and reduce rapidly to 100 micrograms/kg on alternate days [to nearest 1 mg or 5mg tablets]). Stop as soon as possible.

Children on inhaled or oral steroids should have regular checks of their growth and be watched for steroid side effects (for example oral thrush)

The control of asthma should be regularly reviewed (for example three-monthly) and medication stepped up or down dependent on symptoms. Families should have written instructions and may learn to change treatment themselves, with support.

Management of an episode of acute asthma

Initial treatment of a **mild to moderate acute attack** of asthma includes:

- Reassure child and parents and avoid upset which may exacerbate respiratory distress
- Give regular inhaled beta-2 agonist bronchodilator, for example salbutamol aerosol 200-1000 micrograms (2 to 10 sprays each of 100 mcg with each spray given after every 4-5 breaths) via spacer maximum every 30 minutes to 2hourly until the child is better.
- OR if not responding to spacer 2.5 mg for <5 years and 5 mg for >5 years via nebuliser 2-4 hourly (use oxygen to drive the nebuliser if possible)
- Give systemic steroids: oral prednisolone 1mg/kg (maximum of 40 mg) for 3-5 days depending on duration of symptoms with food or milk to avoid gastric irritation
- Treat or remove any exacerbating factors (see "Diagnosis" above).
- Give antibiotics only if signs of pneumonia, especially a persistent fever

Very severe or life-threatening asthma

Features of severe or life-threatening asthma include:

Section 15 Paediatric emergencies: severe asthma

- too breathless to feed, drink or talk
- marked recession/use of accessory muscles
- respiratory rate > 50 breaths/min
- pulse rate > 140 beats/min
- poor chest movement/silent chest
- exhaustion/agitation/reduced conscious level (due to hypoxia or hypercapnia)
- hypoxaemia SpO₂ less than 90% in air or cyanosis (very late sign)

Treat immediately (use 'ABC' approach):

- **100% oxygen** via facemask held by parent or nurse close to child's face with reservoir bag at 10-15 litres/min or if appropriate nasal cannulae to keep SaO₂ 94-98%.
- Inhaled beta-2 agonist **bronchodilator** via spacer as above in acute asthma, that is **salbutamol aerosol** 1000 micrograms (10 sprays each of 100 mcg with each spray given after every 4-5 breaths) via spacer maximum every 10 minutes and if no better use nebuliser as below. If nebuliser not available, continue to give 10 sprays over 40-50 breaths every 10 to 30 minutes until better.
- Children aged <3 years are likely to require a face mask connected to the mouthpiece of a spacer for successful drug delivery.
- Inhalers should be sprayed into the spacer in individual sprays and inhaled immediately by tidal breathing.
- Or inhaled from a **nebuliser 2.5 mg nebuliser** for <5 years and 5 mg for >5 years, and repeated as required (ideally drive the nebuliser with oxygen at 6-8 litres/minute rather than compressed air). Sometimes nebulisers made be needed continuously (described as back-to-back that is as each nebule finishes repeat)
- If nebulised or inhaled B agonist bronchodilators are not available, give a **subcutaneous injection of adrenaline**—10 micrograms/Kg (0.01 ml/kg of 1:1000 solution) (up to a maximum of 300 micrograms), measured accurately with a 1 ml syringe (**ensure the needle is not in a vein before injecting**). If there is no improvement after 15 minutes, repeat the dose once.
- **Systemic steroids oral** prednisolone (see above) or IV/IM hydrocortisone 4 mg/kg 4-6 hourly until no longer has symptoms of an acute episode. Start the steroids as soon as possible. A soluble preparation dissolved in a spoonful of water is preferable in those unable to swallow tablets. Use a dose of 20 mg for children 2-5 years old. Repeat the dose of prednisolone in children who vomit and give intravenous (or IM if a venous cannula cannot be inserted) hydrocortisone (4 mg/ kg repeated four-hourly) in those who are unable to retain orally ingested medication. Treatment for three to five days is usually sufficient, but the length of course should be tailored to the number of days necessary to bring about recovery. Weaning is unnecessary unless the course of steroids exceeds 14 days.

Section 15 Paediatric emergencies: severe asthma

IF 2-3 DOSES OF INHALED BRONCHODILATOR AND SYSTEMIC STEROIDS DO NOT RESULT IN IMPROVEMENT OR IF LIFE-THREATENING FEATURES ARE PRESENT, USE:

- **intravenous beta-2 agonist salbutamol** (loading dose 5-15 micrograms/kg over 10-15 min, followed by 100-500 nanograms/kg/min (that is 0.1-0.5 micrograms/kg/min) by IV infusion OR
- **Intravenous magnesium sulphate** 40 milligrams / kg (maximum 2 grams) over 20 minutes OR
- an alternative to the above treatments include aminophylline (loading dose 5 mg/kg over 20 minutes, followed by 1 mg/kg/hour by IV infusion if 1-12 years and 500 micrograms/kg/hour if > 12 years or < 1 year of age. Do not give the loading dose if already received any form of aminophylline or caffeine in the previous 24 hours. Side effects include nausea, vomiting, tachycardia or tachyarrhythmia and seizures and have made this a less preferred treatment.

Severe and life-threatening hypokalaemia may occur with IV salbutamol, potentiated by steroids. If possible monitor the ECG continuously and check K⁺ 12 hourly. ECG signs of hypokalaemia are: ST depression, T wave reduction and prominent U waves. Ensure maintenance potassium intake is given.

If there is poor response to the above treatment, or the child's condition worsens suddenly, obtain a chest X-ray to look for evidence of pneumothorax. In the presence of hyperinflation from asthma, detection of a pneumothorax on the chest x ray may be difficult.

Monitor above clinical features regularly and also monitor oxygen saturation, by pulse oximeter if available. Keep SpO₂ 94-98% by the administration of oxygen, either by face mask or by nasal cannulae. Use oxygen to drive nebulisers. In cases not responding to above measures, obtain chest Xray and consider mechanical ventilation (slow rate, long expiration). A blood gas measurement showing respiratory acidosis can be valuable at this time, but remember that invasive procedures can worsen respiratory distress.

If intubation and ventilation becomes essential, ketamine induction followed by inhalational anaesthetic gases (for example halothane) may assist broncho-dilatation.

Severe Asthma - Indications for intubation and ventilation (if available):

- Increasing exhaustion
- Progressive deterioration in
 - clinical condition
 - oxygenation decreasing and/or oxygen requirement increasing
 - pCO₂ increasing (if measurable from arterial/capillary gas)
- Sudden deterioration – and always think about a pneumothorax

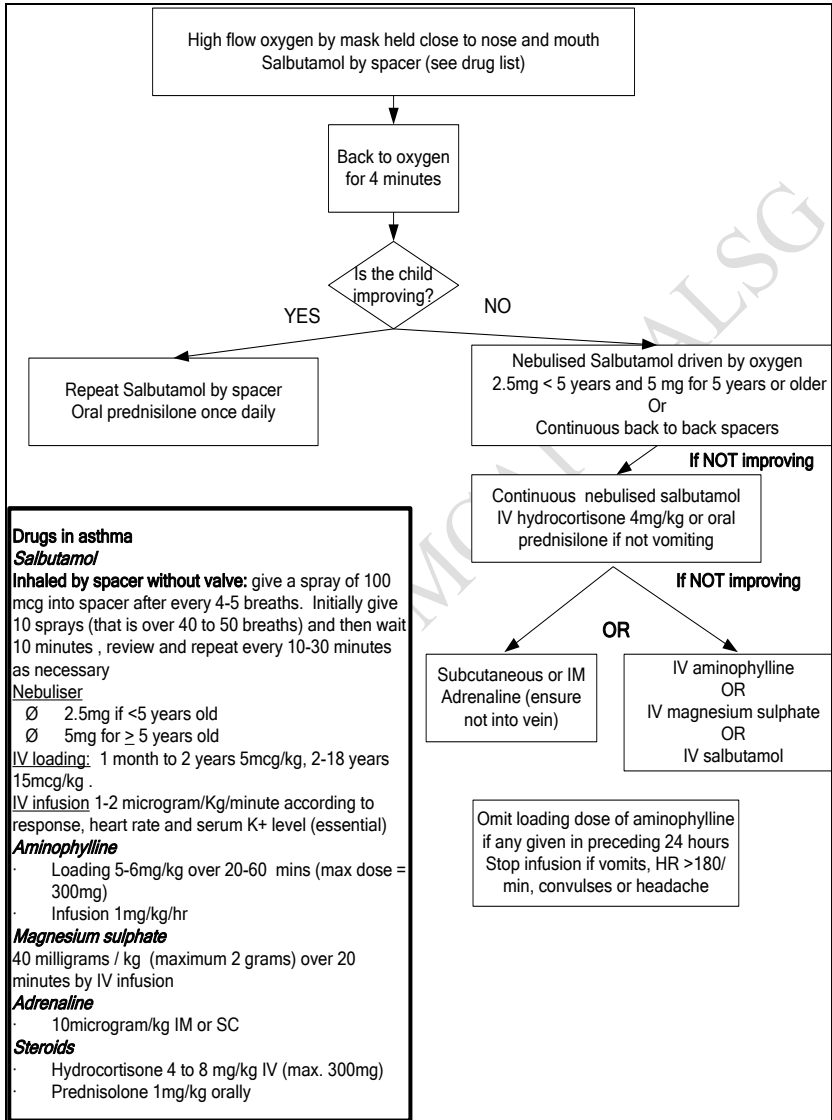
Follow-up care

Once improved sufficiently to be discharged home, inhaled salbutamol through a metered dose inhaler should be prescribed with a suitable (not necessarily commercially available) spacer and the parents instructed in how to use this.

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Section 15 Paediatric emergencies: severe asthma

Pathway of Care for Severe Asthma



Acute lower respiratory tract infection

Always consider that the child might be suffering from TB or HIV infection.

A high fever in a child with breathing difficulties is likely to be due to epiglottitis, bacterial tracheitis or pneumonia. If the airway is clear, the most likely diagnosis is pneumonia. Although high fever and respiratory signs are the usual way for pneumonia to present, it should always be considered in the list of causes of abdominal pain and neck stiffness

Clinical examination (and CXR) cannot reliably tell the difference between a viral and a bacterial pneumonia, so all cases are treated with antibiotics

Features of Pneumonia

- Fever, cough, breathlessness and lethargy following an upper respiratory infection
- Pleuritic chest pain, abdominal pain and neck stiffness indicate pleural involvement
- Signs of consolidation
 - Dull percussion
 - Reduced breath sounds
 - Bronchial breathing
 May be absent in an infant
- CXR may show pleural effusion or empyema as well as consolidation

Treatment

- Oxygen to maintain $\text{SaO}_2 > 94\%$
- IV antibiotics
 - Cefotaxime plus either
 - Flucloxacillin
 - OR**
 - Erythromycin
 - WHO benzyl penicillin and amoxicillin (see below)
- Maintain hydration and replace losses due to high fever
- Do not overload
- CXR is helpful, but not essential

CLASSIFICATION OF THE SEVERITY OF PNEUMONIA (WHO)

Sign or symptom	Classification	Treatment
Cough or difficult breathing plus at least one of the following: <ul style="list-style-type: none"> ○ central cyanosis ○ inability to breastfeed or drink, or vomiting 	Very severe pneumonia	Admit to hospital Give recommended antibiotic Give oxygen Manage the airway

Section 15 Paediatric emergencies: pneumonia

- Alternatively, give chloramphenicol (25 mg/kg IM or IV every 8 hours) until the child has improved. Then continue orally 4 times a day for a total course of 10 days. Or use ceftriaxone (80 mg/kg IM or IV once daily).
- If the child does not improve within 48 hours, switch to gentamicin (7.5 mg/kg IM once a day) and cloxacillin (50 mg/kg IM or IV every 6 hours), as described below for staphylococcal pneumonia. When the child improves, continue cloxacillin (or dicloxacillin) orally 4 times a day for a total course of 3 weeks.

Oxygen therapy

Give oxygen to all children with very severe pneumonia

Oxygen if SaO₂ < 90% (WHO) or < 94% ESSEMCH until the signs of hypoxia (such as severe lower chest wall in-drawing or breathing rate of ≥70/minute) are no longer present. Nurses should check every 3 hours that the catheter or prongs are not blocked with mucus and are in the correct place and that all connections are secure.

Supportive care

- If the child has fever (≥39 °C or ≥102.2 °F) which appears to be causing distress, give paracetamol.
- If wheeze is present, give a rapid-acting bronchodilator
- Remove by gentle suction any thick secretions in the throat, which the child cannot clear.
- Ensure daily maintenance fluids appropriate for age but avoid over-hydration.
 - Encourage breastfeeding and oral fluids.
 - If the child cannot drink, insert a nasogastric tube and give maintenance fluids in frequent small amounts. If the child is taking fluids adequately by mouth, do not use a nasogastric tube. If oxygen is given at the same time as nasogastric fluids, pass both tubes through the same nostril.
- Encourage eating as soon as food can be taken.

Complications

If not improved after two days, or if condition has worsened, if possible, obtain a chest X-ray.

Staphylococcal pneumonia. This is suggested if there is rapid clinical deterioration despite treatment, by a pneumatocele or pneumothorax with effusion on chest X-ray, numerous Gram-positive cocci in a smear of sputum, or heavy growth of *S. aureus* in cultured sputum or empyema fluid. The presence of septic skin pustules supports the diagnosis.

Treat with cloxacillin (50 mg/kg IM or IV every 6 hours) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves, continue cloxacillin orally 4 times a day for a total course of 3 weeks. Note that cloxacillin can be substituted by another anti-staphylococcal antibiotic such as oxacillin, flucloxacillin, or dicloxacillin.

Pleural effusion and empyema

Diagnosis

On examination, the chest is dull to percussion and breath sounds are reduced or absent over the affected area.

A pleural rub may be heard at an early stage before the effusion is fully developed.

Section 15 Paediatric emergencies: heart failure

A chest X-ray shows fluid on one or both sides of the chest.

(An ultrasound examination may be helpful in identifying the size of the effusion and helping to guide drainage ESS-EMCH)

When empyema is present, fever persists despite antibiotic therapy and the pleural fluid is cloudy or frankly purulent.

Treatment

Drainage

Pleural effusions should be drained, unless they are small. If effusions are present on both sides of the chest, drain both. It may be necessary to repeat drainage 2–3 times if fluid returns.

Subsequent management depends on the character of the fluid obtained. Where possible, pleural fluid should be analysed for protein and glucose content, cell count and differential count, and examined after Gram and Ziehl-Neelsen staining, and bacterial and Mycobacterium tuberculosis culture.

Failure to improve

If fever and other signs of illness continue, despite adequate chest drainage and antimicrobial therapy, assess for possible tuberculosis. A trial of antituberculosis therapy may be required

Heart failure

Heart failure causes fast breathing and respiratory distress.

Underlying causes include congenital heart disease (usually in the first months of life), acute rheumatic fever, myocarditis, suppurative pericarditis with constriction, infective endocarditis, acute glomerulonephritis, severe anaemia, very severe pneumonia and severe malnutrition.

Heart failure can be precipitated or worsened by fluid overload, especially when giving salt-containing IV fluids.

Diagnosis

The most common signs of heart failure, on examination, are:

- Tachycardia (heart rate >160/minute in a child under 12 months old; >120/minute in a child aged 12 months to 5 years).
- Gallop rhythm
- Basal crackles on auscultation.
- Enlarged, tender liver.

In infants—fast breathing (or sweating), especially when feeding

In older children oedema of the feet, hands or face, or distended neck veins (raised JVP).

Severe palmar pallor may be present if severe anaemia is the cause of the heart failure. If the diagnosis is in doubt, a chest X-ray can be taken and will show an enlarged heart. Measure blood pressure if possible. If raised consider acute glomerulonephritis: microscope urine

Treatment

The main measures for treatment of heart failure in none-severely malnourished children are:

Section 15 Paediatric emergencies: heart failure

Diuretics. Give frusemide a dose of 1 mg/kg should cause increased urine flow within 2 hours. For faster action, give the drug IV. If the initial dose is not effective, give 2 mg/kg and repeat in 12 hours, if necessary. Thereafter, a single daily dose of 1–2 mg/kg orally is usually

sufficient. Maximum is around 40mg per dose, but can give more.

Digoxin.

Supplemental potassium. Supplemental potassium is not required when frusemide is given alone for treatment lasting only a few days. When digoxin and frusemide are given, or if frusemide is given for more than 5 days, give oral potassium (3–5 mmol/kg/day).

Oxygen. Give oxygen if the child has a respiratory rate of ≥ 70 /min, shows signs of respiratory distress, or has central cyanosis or an oxygen saturation of $< 94\%$ (EMCH).

Supportive care

- Avoid the use of IV fluids, where possible.
- Support the child in a semi-seated position with head and shoulders elevated and lower limbs dependent.
- Relieve any fever with paracetamol.

Management of the Infant or Child in Shock

Shock is defined as inadequate perfusion of vital organs with adequately oxygenated blood. Management of shock is focused in two areas

- Resuscitation and support for the circulation, after making sure the airway and breathing are stable and supported
- Treatment of the underlying cause

There are many causes of shock

- Loss of fluid e.g. gastroenteritis; trauma
- Redistribution of fluid e.g. septicaemia; anaphylaxis
- Failure of circulation e.g. cardiac disease; tension pneumothorax

It is often possible to identify the cause of shock with a good history and a careful examination.

Diagnostic pointers to the cause of shock	
Diarrhoea and / or vomiting	Gastroenteritis; volvulus; intussusception
Fever; non-blanching (purpuric) rash	Septicaemia, Dengue Haemorrhagic Fever
Urticaria; wheeze; oedema; exposure to allergen	Anaphylaxis
Trauma	Blood loss; tension pneumothorax; internal bleeding
Burns	Fluid loss; blood loss
Baby < 4 weeks old; cyanosis, with no response to oxygen	Congenital heart disease
Very fast pulse; heart failure	Arrhythmia; cardiomyopathy
Dehydration, polyuria, polydipsia, high glucose	Diabetic keto-acidosis
History of sickle cell disease or diarrhoeal illness and low	Haemolysis with severe anaemia

Section 15 Paediatric emergencies: shock, dehydration and severe diarrhea

haemoglobin	
Pallor, tachycardia, malnutrition	Severe anaemia

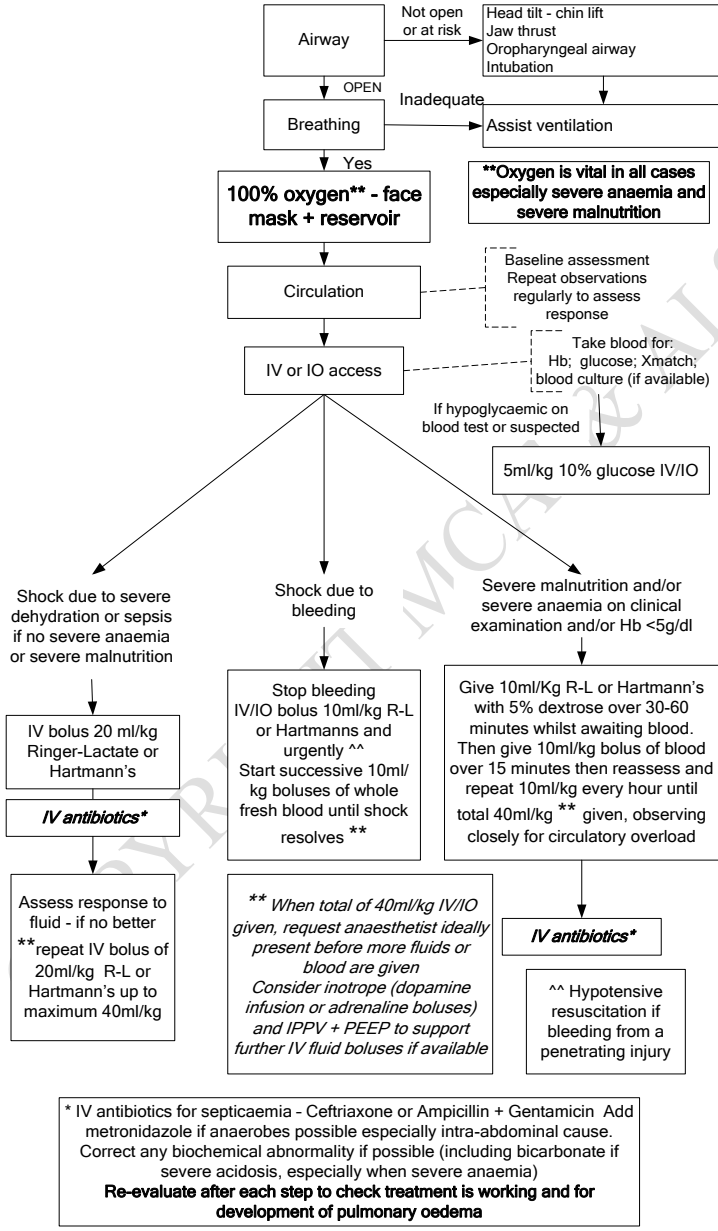
Initial Management of Shock

Even though it may be clear on initial inspection that the child is in shock, the first priority will still be the airway, followed by breathing and then management of the circulation. Intravenous access with short, wide venous cannula, or placement of an intraosseous line (see procedures) is important. It is best to try and get more than one line in case rapid fluid resuscitation is needed. Always take blood for investigations (if available)

FBC; glucose; renal and liver function; blood culture and cross matching

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Pathway of Care for the Child in Hypovolaemic/Septic Shock



Specific illnesses causing shock

The most important thing to do is to give high dose oxygen, stabilise the circulation and maintain perfusion of vital organs. Once this is underway, the cause of the problem needs to be treated.

Dehydration

- Dehydration is loss of water, sodium and other essential electrolytes
- Children are at greater risk because of their higher percentage of total body water
- The most common causes are gastroenteritis and diabetic ketoacidosis
- It is important to also consider surgical causes of dehydration, such as intussusception and volvulus
- Most can be treated with oral rehydration solution (ORS) by mouth or NG tube
- In children with severe malnutrition, use a solution with a lower sodium content such as ReSoMal. Care for patients with malnutrition is discussed later.

Dehydration is classified by the percentage of body water lost and is usually only an estimate.

Classification of Dehydration

Dehydration is classified according to clinical criteria. This may not apply in severe malnutrition where CARE IS NEEDED

No dehydration <3% wt loss = NO SIGNS!

Some dehydration 3-9% wt loss

Increased thirst, drinks eagerly: dry mucous membranes: loss of skin turgor, tenting when pinched : sunken eyes: sunken fontanelle in infants: restless or irritable behavior

Severe dehydration $\geq 10\%$ wt loss

- More pronounced effects of signs seen in moderate dehydration
- Lack of urine output
- Lack of tears when crying
- Not able to drink or drinks poorly
- Hypovolaemic shock, including:
 - rapid and feeble pulse (radial pulse may be undetectable)
 - low or undetectable BP
 - cool and poorly perfused extremities
 - decreased capillary refill (> 3s)
 - peripheral cyanosis
- Rapid, deep breathing (from acidosis)
- Altered consciousness or coma
- Lethargy

Emergency treatment of severe dehydration: Principles of treatment

1. Recognise and treat shock

- Give a fluid bolus 20ml/kg **Ringer-Lactate or Hartmann's IV**
- A second bolus may be needed if the child does not respond well (see the "shock" pathway)
- It is unusual to need more than this in cases of dehydration due to gastroenteritis – think of other causes. If sepsis is suspected, treat with IV antibiotics

2. **Decide on the most likely cause** of dehydration

3. **Decide what level of dehydration** you are treating (see above)

Calculate the fluid deficit, maintenance needs and on-going losses (see below)

When shock has resolved and the patients level of consciousness returns to normal, the remaining estimated deficit MUST BE TAKEN by mouth or by gastric tube especially if severe malnutrition and/or anaemia (danger of large fluid volume IV)

- In severe cases, intubation, ventilation, CVP monitoring and inotrope support might be indicated, if these are available
- Check the serum sodium, and if >155mmol/l, reduce it slowly over 48 hrs. Too rapid a reduction in sodium leads to cerebral oedema
- Further tests might include abdominal X-ray or ultrasound, if there is concern regarding a distended abdomen.
- A surgical opinion is needed if bile stained vomiting or abdominal guarding

Calculating Fluid Requirements

WHO Plans A-C for gastroenteritis in children (see Pathway of care) include estimates of total fluid requirements and assume that most children will be drinking by 4 hours into treatment and thus able to "self-regulate". For patients where this is not the case, Fluid Management can be conducted using the following guidelines.

Estimating Fluid requirements

The amount of fluid that the child needs over a 24 hour period needs to be calculated. It is the sum of:

Estimated fluid deficit + maintenance requirements + on-going losses

Deficit

If an accurate recent pre-illness weight is available, subtract current weight to estimate lost fluid (1 kg = 1 litre of fluid)

eg a child who weighed 9.2 kg is seen with diarrhea and weight 8.3kg:
 estimated fluid loss is $[9.2 - 8.3] \text{kg} = 0.9 \text{kg} = 900 \text{ml}$ deficit, that is 10% dehydrated

If no recent weight or considered to be unreliable:

decide degree of dehydration

weigh child (or estimate from age as follows: $\text{wt}(\text{kg}) = 2 \times [\text{age}(\text{yrs}) + 4]$)

use formula: **% dehydration x weight (kg) x 10 = deficit (in mls)**

eg a child whose weight is estimated as 10 kg is 10% dehydrated:
 estimated fluid loss is $10 \times 10 \times 10 = 1000 \text{ mls}$ (40 ml/hour if replaced over 24 hours)

Maintenance

Estimated maintenance fluid requirements based on body weight for a child are:

Body weight	Fluid needed per day	Fluid needed per hour
First 10kg body weight	100 ml/kg	4 ml/kg
Second 10kg	50 ml/kg	2 ml/kg
Subsequent kg	20 ml/kg	1 ml/kg

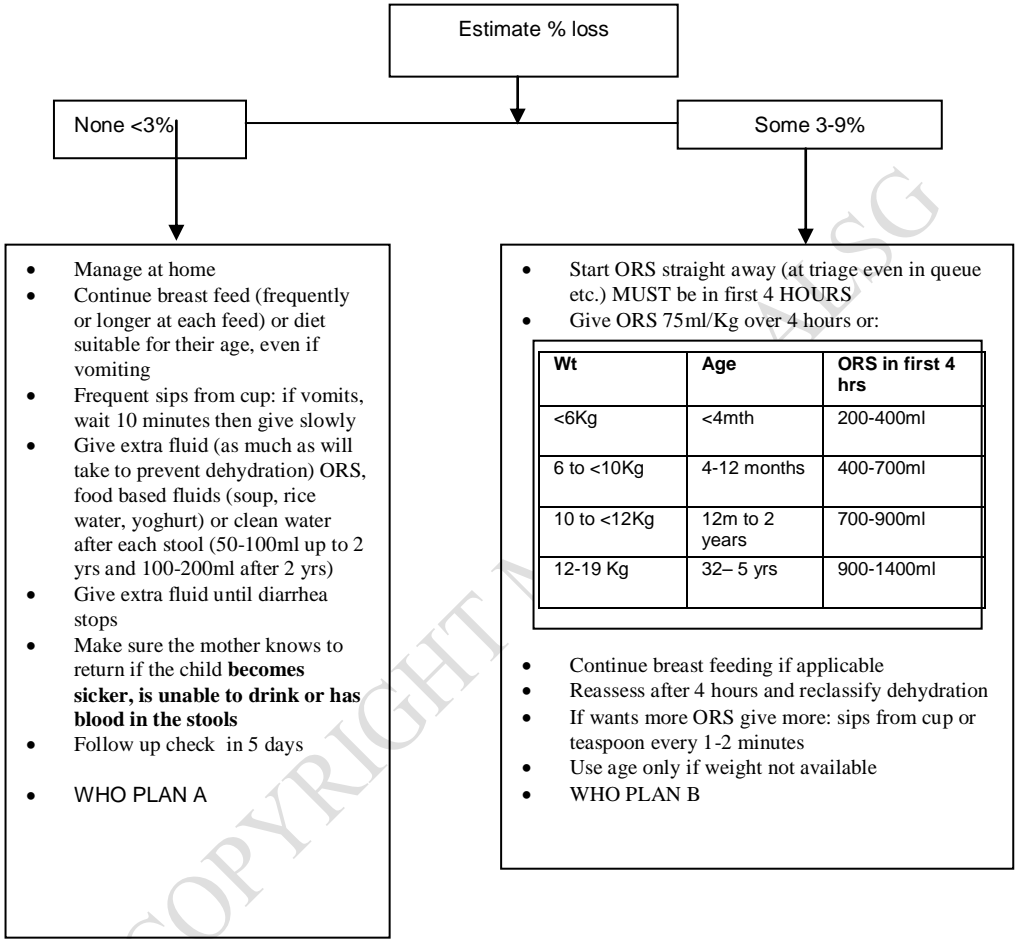
Ongoing losses

for each diarrhea stool	<2 yrs old, give 50-100 ml > 2 yrs old give 100-200 ml
for each vomit	2ml / kg ORS: give small frequent volumes (eg 5ml every minute in a child) via spoon or syringe or cup
For naso-gastric tube aspirates	Replace volume for volume with either ORS or Ringer-Lactate or Hartmann's with 5 or 10% glucose and 5mmol/litre of potassium chloride OR Ringer-Lactate or Hartmann's with 5 or 10% glucose.

Over-hydration

- oedematous (puffy) eyelids may be a sign of over hydration, cardiac failure (as in severe malnutrition) chronic malnutrition or protein losing enteropathy
- cardiac failure (especially in severe malnutrition) chronic malnutrition or protein losing enteropathy
- crepitations at lung bases
- A CXR may be helpful in showing pulmonary plethora or oedema
- stop giving ORS solution, but give breast milk or plain water, and food
- do not give a diuretic unless pulmonary oedema, then give frusemide 1 mg/kg/IV

Pathway for management of gastroenteritis in children (no or some dehydration)



Estimate % loss

None <3%

Some 3-9%

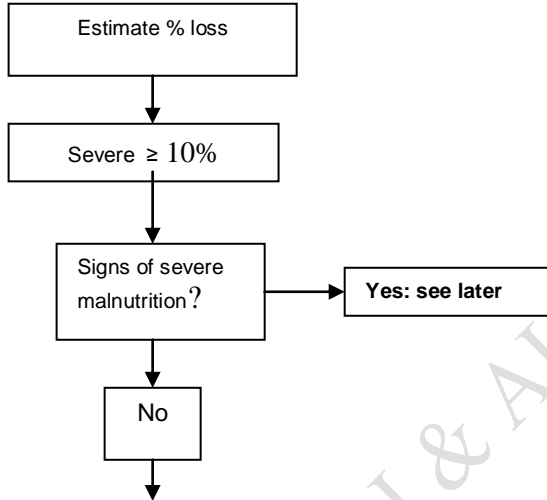
- Manage at home
- Continue breast feed (frequently or longer at each feed) or diet suitable for their age, even if vomiting
- Frequent sips from cup: if vomits, wait 10 minutes then give slowly
- Give extra fluid (as much as will take to prevent dehydration) ORS, food based fluids (soup, rice water, yoghurt) or clean water after each stool (50-100ml up to 2 yrs and 100-200ml after 2 yrs)
- Give extra fluid until diarrhea stops
- Make sure the mother knows to return if the child **becomes sicker, is unable to drink or has blood in the stools**
- Follow up check in 5 days
- WHO PLAN A

- Start ORS straight away (at triage even in queue etc.) **MUST** be in first 4 HOURS
- Give ORS 75ml/Kg over 4 hours or:

Wt	Age	ORS in first 4 hrs
<6Kg	<4mth	200-400ml
6 to <10Kg	4-12 months	400-700ml
10 to <12Kg	12m to 2 years	700-900ml
12-19 Kg	32- 5 yrs	900-1400ml

- Continue breast feeding if applicable
- Reassess after 4 hours and reclassify dehydration
- If wants more ORS give more: sips from cup or teaspoon every 1-2 minutes
- Use age only if weight not available
- WHO PLAN B

Section 15 Paediatric emergencies: shock, dehydration and severe diarrhea
Pathway for management of gastroenteritis in children (severe $\geq 10\%$)



- If shocked, follow 'Shock Pathway'
- Give ORS and start IV fluids
- Either WHO PLAN C OR Estimate deficit, maintenance needs and on-going losses

Deficit in mls
 $\% \text{ dehydration} \times \text{wt (kg)} \times 10$
 In 10% dehydration = 100ml/kg

Maintenance		
Body wt	Fluid/24hrs	Fluid/hr
1 st 10 kg	100ml/kg	4 ml/kg
2 nd 10kg	50ml/kg	2 ml/kg
Subsequent kg	20ml/kg	1ml/kg

On-going losses
 After each loose stool give extra fluid
 $\leq 2\text{yrs old give } 50\text{-}100 \text{ ml}$
 $> 2 \text{ yrs old give } 100\text{-}200\text{ml}$

Fluid replacement

- Start IV at once and give 100ml/kg Ringer- lactate or Hartmann's as follows

Infants < 1 year	30ml/kg in 1 hour	Then 70ml/kg in 5 hrs
Children ≥ 1 year	30ml/kg in 30 mins	Then 70ml/kg in 2.5 hrs

- Repeat once if pulse still very weak
- If available check initial U&E and repeat at 4 hours
- Give ORS as soon as child can drink (about 5ml/kg/hr)
- Reassess and re-classify at 3 hrs for child and 6 hours for infant
- If no IV/IO access, give fluid through NGT at 20ml/kg/hr for 6 hours
- Do not discharge patient until oral re-hydration is established

Consider and treat severe hypokalaemia

In poorly resourced countries severe hypokalaemia with acidosis is common in severe gastroenteritis (BMJ 2002:324;369-270). Potassium replacement here needs to be at a higher rate than recommended; namely up to 2mmol/Kg per hour and up to a maximum daily requirement of 15mmol/Kg/24 hours. Earlier we suggested the following regime for treating severe hypokalaemia: Initially an IV infusion of 0.5mmol/Kg over 30 minutes followed by an IV infusion of potassium not exceeding 0.5mmol/Kg per hour.

Reassess

- ABC
- state of intravascular repletion
- plasma electrolytes if possible
- urine output and urine electrolytes
- give fluid according to plan, don't forget ongoing losses
- reassess regularly (including biochemistry if possible)
- don't forget glucose

Gastroenteritis in Childhood

Gastroenteritis is an acute infection of the small bowel leading to diarrhoea, and often vomiting, and is common in children below the age of three years. In 80% of cases it is viral and settles over 3-5 days. Bacterial cases may be associated with prolonged or severe symptoms and a higher fever. Dehydration risk is greatest in infants < 1 year old; stool frequency > 8/day; vomiting for > 2 days

Making the diagnosis

Diarrhoea, abdominal discomfort +/- vomiting; headache and fever often present
Alternative diagnoses – especially if vomiting is more prominent than diarrhoea

- Surgical abdomen
 - Intussusception / Appendicitis / Volvulus / Incarcerated hernia
- Medical causes – DKA; pneumonia

Infants and young children are more likely than older children or adults to present with shock due to sudden fluid loss in gastro-enteritis or with **concealed fluid loss secondary to a surgical abdomen such as a volvulus. Cholera** is also a common cause.

In infants gastroenteritis may occasionally present as a circulatory collapse with little or no significant preceding history of vomiting or diarrhea. The infecting organism can be any of the usual diarrhea pathogens, of which the most common is rotavirus. The mechanism leading to this presentation is that there is a sudden massive loss of fluid from the bowel wall into the gut lumen, causing depletion of the intravascular volume and the appearance of shock in the infant. This occurs before the stool is passed so that the diagnosis may be unsuspected. Usually during resuscitation of these infants, copious watery diarrhea is evacuated.

Section 15 Paediatric emergencies: shock, dehydration and severe diarrhea

Management

The two essential elements in management of all children with diarrhea are re-hydration and continued feeding. Do not give any drugs to control diarrhea or vomiting, as they can have serious side effects, and do not improve hydration or nutritional status. Only give antibiotics if there is acute bloody diarrhea or suspected cholera.

Oral Fluids

Recommendations for oral replacement therapy in gastroenteritis are:

- use either low-sodium ORS (containing 40-60 mmol/L of sodium), or
- if unavailable, use ORS containing 75-90 mmol/L of sodium and 75mmol/l of glucose with an additional source of low-sodium fluid (eg breast milk, formula, or clean water)
- encourage the mother to continue breastfeeding her child
- giving high osmolar fluids may contribute to hypernatraemia, whilst giving water alone, or low salt drinks may cause hyponatraemia
- oral glucose within ORS enhances electrolyte and water uptake in the gut
- Avoid high sugar drinks (hyper-osmolar) e.g. coca cola or fruit juices can worsen diarrhea by their osmotic effects.

Intravenous Fluids

- even in patients who are drinking poorly, try to give enteral fluids by mouth or by gastric tube until the IV drip is running
- use Ringer's Lactate or Hartmann's Solution which has Na 131mmol/l; K 5mmol/l; HCO₃ 29mmol/l; Ca 2mmol/l
- Hartmann's solution has no glucose to prevent hypoglycaemia: this can be corrected by adding 100ml of 50% glucose to 500ml of Hartmann's giving approximately a 10% glucose solution (adding 50ml gives a 5% solution)
- Ringer's Lactate Solution already prepared with 5% dextrose has the added advantage of providing glucose to help prevent hypoglycaemia.
- If Ringer's Lactate or Hartmann's is unavailable, use 0.9% saline. It does not contain a base to correct acidosis and does not replace potassium losses, therefore add 5mmol/litre of Potassium Chloride. Also it does not contain glucose and therefore add 100ml of 50% glucose to 500ml of 0.9% saline to give approximately a 10% glucose solution.
- **do NOT use plain 5% glucose solutions, or 0.18% saline + 4% glucose. They do not contain adequate electrolytes, do not correct the acidosis or hypovolaemia and can produce dangerous hyponatraemia**
- all patients should start to receive some ORS solution (about 5 ml/kg/hour) when they can drink without difficulty, which is usually within 3 - 4 hours (for infants) or 1 - 2 hours (for older children). This provides additional base and potassium, which may not be adequately supplied by the IV fluid. Alternatively give as soon as possible by gastric tube.

Management of diarrhea using WHO guidelines

See pathway of care above for plans A and B (no or some dehydration)

Diarrhea with severe dehydration

If no signs of severe malnutrition: **Plan C treatment:**

While setting up IVI (or Intraosseous if needed), give ORS

Start IV immediately; 100mls/kg of Ringer-Lactate or Hartmann's divided as follows:

Section 15 Paediatric emergencies: shock, dehydration and severe diarrhea

Age	First give 30ml/Kg in:	then give 70mls/kg in
Infants < 12 months	1 hour *	5 hours
Children 1 to 5 years	30 minutes *	2.5 hours

* Repeat once if pulse is still very weak; reassess every 15-30 minutes until strong radial pulse present:

- then reassess every 1-2 hours – if hydration not improving give IV more rapidly. If available take U&E initially and at 4 hours but don't let this delay your treatment.
- Also give ORS (about 5mls/kg/hour) as soon as the child can drink
- Reassess and Reclassify
- at 3 hours for child, 6 hours for infant and choose appropriate plan for continued management
- If IV or IO access not possible, and child not able to drink, give ORS by NGT at 20mls/kg/hour for 6 hours, reassessing every 1-2 hours (IV or IO access must be obtained if hydration status not improving)
- If possible, observe the child for at least 6 hours after rehydration to be sure adequate hydration can be maintained orally.

If signs of Severe Malnutrition:

- Remember that dehydration is generally over diagnosed in malnourished children, but that low circulating volume can co-exist with oedema
- Do NOT use IV route for rehydration **except in cases of shock**.
- Standard ORS is not suitable (Sodium too high, Potassium too low); use ReSoMal (can be prepared by adding one 1 litre WHO-ORS packet to 2 litres of water, adding 50g Sucrose and 40 mls of Electrolyte/mineral solution)
- Give ReSoMal PO or NG more slowly than well-nourished child rate:
 - 5mls/kg every 30 minutes for first 2 hours
 - then 5-10 mls/kg/hour for the next 4-10 hours
- Then proceed to starter-F-75 solution (see Malnutrition section)
- Monitor every 30 minutes for first 2 hours – be alert to signs of over-hydration (increasing respiratory and pulse rates): stop and reassess after one hour if found

Zinc treatment

All patients with diarrhea should be given zinc supplements as soon as possible after the diarrhea has started.

Up to 6 months give 1/2 tablet (10 mg) per day

6 months and more give 1 tablet (20 mg) per day for 10–14 days

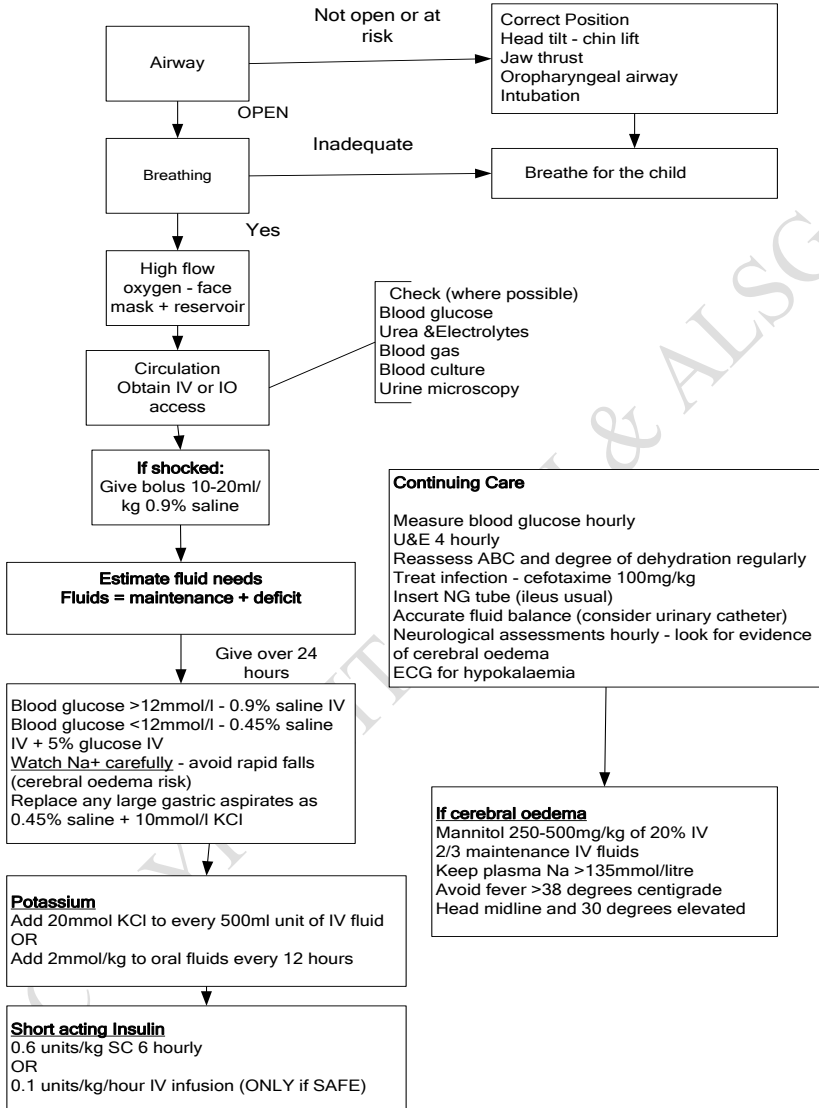
Diabetic Ketoacidosis

DKA is the commonest endocrine emergency and should be suspected in any patient presenting with dehydration, abdominal pain, ketotic breath, altered level of consciousness. The mainstay of treatment is to correct dehydration, reduce blood glucose levels and treat any inter-current infection. The most serious acute complication of DKA is cerebral oedema (mortality rate 80%) which is thought to be due to over vigorous resuscitation

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Section 15 Paediatric emergencies: shock, diabetic ketoacidosis

Pathway of care for DKA



Septicaemia

Introduction

Septic shock develops when a number of different mechanisms of shock operate in the context of an invasive bacterial infection (an exception is dengue which is caused by a viral agent). These mechanisms are:

- hypovolaemic: from abnormal capillary permeability, fever and accompanying vomiting and diarrhoea
- distributive: there is loss of the normal sympathetic nervous system control of vascular tone so that blood is lost from vital organs into non-vital areas
- cardiogenic: impaired cardiac function secondary to hypovolaemia and the toxic effects of the pathogen

These multiple factors make septic shock difficult and complex to treat and contribute to a high mortality rate in these conditions.

The bacteria causing septic shock include meningococcus, staphylococcus, streptococcus pneumoniae and pyogenes, together with gram negative organisms like *E. coli* which particularly affect patients at risk with lower immunity, such as the newborn, those with HIV/AIDS and the malnourished.

Diagnosis of septic shock

The early recognition and treatment of septic shock is key to a good outcome, so a high degree of vigilance for this condition is necessary.

In a child who has an infection, with a fever (although the at risk group mentioned above may have a normal or subnormal temperature), the development of a change in mental status, such as irritability, drowsiness, lack of interaction or reduced or absent eating or breast feeding is often the first feature to alarm parents and is the result of the effect of poor cerebral perfusion and possible accompanying hypoglycaemia on the child's brain. The signs which should then be sought include the following:

- tachycardia (best measured with a stethoscope)
- weak pulse (ideally central - brachial, femoral or carotid but difficult to gauge)
- reduced urine output (early sign)
- cold skin with poor circulation or sometimes peripheral skin vasodilatation
- prolonged capillary refill time (CRT) > 3 seconds
- agitation, anxiety
- increased skin sweating in some cases
- extreme central pallor (in cases with severe anaemia)
- raised respiratory rate (due to acidosis)
- reduced conscious level (serious and dangerous sign)
- low BP (late sign and difficult to measure in young children: needs the correct sized cuff)

Meningococcal septicaemia

Purpuric non-blanching rash
7% no rash; 15% blanch
not always associated with meningitis

Toxic shock syndrome

high fever, headache, confusion
red conjunctivae and oral mucosa
scarletiform rash+ desquamation
subcutaneous oedema
vomiting and watery diarrhoea

Non-typhoidal salmonella

Common in malarial areas

Difficulties in managing septic shock

In well-resourced countries or well resourced areas of countries with specialist paediatric intensive care units (PICUs) or high dependency units, some cases of septic shock are still difficult to manage and some children die.

In resource poor countries there are additional difficulties which need to be taken into account, as follows:

- *Severe malnutrition:* this makes the diagnosis of septic shock more difficult as the child's malnourished body does not respond with the same physical signs as a well nourished child. In addition, malnourished children may have poor myocardial function and almost always have severe anaemia. This will result in cardiac failure and probable death if rapid infusions of large and repeated boluses of fluid (an important part of septic shock management) are given (see chapter 5.10.B)
- *Severe anaemia:* as shock is a failure of oxygen delivery to the tissues, clearly anaemia will make this worse. Rapid crystalloid fluid infusion will dilute the blood further and worsen the heart failure which may be present in severe anaemia. These children need early fresh whole blood transfusion where the red cells will improve oxygen carrying capacity: the plasma will support the circulation and supply coagulation factors. If only stored blood is available, it should be packed to provide predominantly red blood cells. In the absence of a suitable centrifuge, hanging the bag vertically allows red cells to fall to the bottom of the pack and these can be transfused first.
- *HIV/AIDS:* again diagnosis may be difficult, physical signs and laboratory tests may be unreliable. A low threshold for treatment of suspected sepsis with broad spectrum antibiotics is recommended (see chapter 6.2.D)
- *Lack of PICU or high dependency care facilities:* even in children with good nutrition, no severe anaemia and no other long term debilitating condition, the amount of fluid infusion required to successfully treat some cases of septic shock is sufficient to induce heart failure and pulmonary oedema. If facilities are available, intubation and ventilation, the IV infusion of inotropic drugs such as dopamine and adrenaline, invasive cardiovascular monitoring, renal dialysis and other aspects of paediatric intensive care are required. The absence of these facilities limits the treatment that can be offered to children with septic shock.

Initial management of septic shock

Even though it may be clear on initial inspection that the child is in shock, the first priority will still be to call for help, manage the airway, followed by breathing and then manage the circulation.

Call for help

Airway

Assess the airway by the simple technique of asking the child 'are you alright?' any vocalisation such as a reply or crying indicates an open airway and some ventilation. In the absence of a response, formally open the airway with a head tilt/chin lift or a jaw thrust manoeuvre and assess breathing by looking, listening and feeling for its presence.

Breathing

All children with suspected shock must receive high flow oxygen.

If possible, this should be given through a mask with a reservoir to achieve the higher concentrations. In the absence of spontaneous breathing give assisted ventilation with a bag/mask.

Circulation

Section 15 Paediatric emergencies: shock, septicaemia

Some assessment of weight will be necessary to calculate the amounts of fluid and antibiotics to be given. If the child is not malnourished, use the formula: $\text{weight} = 2(\text{age} + 4)$. If the child is malnourished this formula can still be used but perhaps a percentage such as 25-50% removed from the result.

Intravenous access with a short, wide bore venous cannula, or placement of an intraosseous line (see chapter 8.4.b) is vital. More than one line is preferable as rapid fluid resuscitation may be needed and other drugs may need to be given simultaneously but start IV treatment as soon as the first line is in place before seeking additional IV access (unless sufficient staff are available). Take blood for investigations: FBC, glucose, electrolytes (including calcium and lactate if possible), blood group and crossmatch blood in all cases. Treat hypoglycaemia if identified.

First fluid

The next step is to give fluid and antibiotics intravenously.

Malnourished and/or severely anaemic

- If the child is malnourished and/or anaemic ($\text{Hb} < 5 \text{ g}$), fluid must be given much more carefully. Give 10 mL/kg IV over 30 to 60 minutes. The recommended solution is Ringer Lactate solution or Hartmann's solution, each with 5% glucose (insert 50 mL of 50% dextrose into a 500 mL bag of the bolus fluid) but give normal saline (0.9%) if this is all that is available, also with 5% dextrose. For antibiotics see below.
- Give a bolus of 10 mL/kg over 15 minutes of fresh blood (if available) or stored blood as soon as possible
- Assess and if the child is not in clinical heart failure, give another 10 mL/kg bolus over 15 minutes of fresh or stored blood.
- If the child is in heart failure, give 10 mL/kg of blood as packed red cells over 2-3 hours or use a partial exchange transfusion as follows: use a cannula in a large vein, withdraw 5-10 mL of patient's anaemic blood (depending on child's size) and infuse 10-20 mL respectively of new blood over 5 minutes and repeat 10 times.
- If the child is not improving having given the above treatment and antibiotics (see below), further clinical interventions must be determined by the individual situation.

Normal nutrition

If the child is not malnourished infuse a crystalloid such as Hartmann's or Ringer Lactate solution as quickly as possible but give Normal Saline (0.9%) if this is all that is available. In well nourished children, the initial bolus volume of fluid to be given is usually 20 mL/kg which is one quarter of the child's circulating volume. Shock is not usually clinically evident until a quarter of the circulation has been lost, so any child with signs of shock must have lost this amount of fluid from the circulation, at least. So a 12 kg child would need 240 mL of crystalloid. This fluid should be given as quickly as possible, usually over 5-10 minutes. It is easily given by pushing the fluid in using a 50 mL syringe.

Antibiotics

While giving the first bolus of IV fluid, also give IV antibiotics if sufficient staff are available to avoid inducing delays with the first fluid bolus. The choice of antibiotics will depend on the clinical clues as to the infecting organism. In the presence of a purpuric rash (and in a non endemic dengue area) meningococcus is the likely organism, otherwise streptococcus or staphylococcus or gram negative organisms are candidates. A third generation cephalosporin such as ceftriaxone or a combination of gentamycin and a penicillin would be advisable. Flucloxacillin should be added if staphylococcus is suspected, for example if

Section 15 Paediatric emergencies: shock, septicaemia

there are boils or a known abscess. In newborn infants or children with suspected intra-abdominal sepsis, gram negative organisms are likely. Metronidazole to cover anaerobic organisms should be given if clinically appropriate.

Reassessment

The next very important step before a second IV bolus is given is to re-assess the patient's vital signs to see if the fluid has helped. Check the pulse rate, capillary return, limb temperature, blood pressure and pay particular attention to the child's mental status. See how the parent child interaction is occurring. Is the child more or less responsive to the parent? Look for signs of heart failure, that is: raised jugular venous pressure, enlarged liver, crackles in lung bases.

If the child still shows the signs of shock, then give further fluid. If there are signs of fluid overload with or without heart failure, then stop the IV fluid.

Further fluid

If there has been a little improvement or no improvement, give a further bolus of 10-20 mL of fluid. Re-assess the child after each 10 mL/kg of fluid: check the pulse rate, capillary return, limb temperature, blood pressure and alertness: look for signs of heart failure, raised jugular venous pressure, enlarged liver, crackles in lung bases.

Once a total of 40 mL of fluid have been given, there is an increasing risk that you will cause fluid overload with pulmonary oedema which will make the child worse, not better. The problem is that there may still be leakage of fluid out of the circulation (into which you have been infusing the crystalloid or other fluid) which makes the tissues oedematous but leaves the circulation still hypovolaemic and the tissues under perfused.

Inotropes

One response to this situation is to give an infusion of a drug which stimulates the heart to pump harder and supports the circulation (an inotrope). Dopamine is a very potent drug and must be given carefully. It should be given into a peripheral vein or intraosseously at a starting dose of 5 micrograms per kg per minute. The dose can be increased in steps up to 20 micrograms per kg per minute if lower doses do not help.

Dopamine infusion

- Make up 0.3 mg/kg of dopamine in 500 mL of Ringer's Lactate or Hartmann's or normal saline. This will give 0.1 microgram/kg/min if run at a rate of 1 mL/hr. Use a 100 mL paediatric burette in the infusion line for this fluid. The burette can then be filled with a further 100 mL and a further dose of dopamine added when necessary. To give 5.0 microgram/kg/minute, give 50 mL/hr of this dilution in a child. Do not forget that the fluid that you are using for the infusion must be included in your calculations of total fluid given.
- If dopamine is not available or is not having any significant effect in the larger doses, then adrenaline, which is more potent than dopamine, may be tried

Intermittent adrenaline infusions

- Dissolve 0.1 mL of 1 in 10,000 adrenaline in 10 mL of 0.9% saline and give 1 mL IV: check response (in particular of BP) and repeat after 15-30 minutes if it helps to improve perfusion. Then intermittently give further doses as required. 1 mL of this solution is 1 mcg/kg.

It must be stressed that in the absence of paediatric intensive care, the above infusions of inotropic (circulation supporting) drugs are an attempt to save a child in extremis and may not be effective.

Section 15 Paediatric emergencies: shock, septicaemia

Once the infusion of inotropes has been started and the child's vital signs re-assessed, fluid may cautiously be continued, re-assessing frequently and stopping the infusion if signs of heart failure appear.

If there is a skilled person (anaesthetist or surgeon available, the placing of a central venous line would be very helpful to monitor the venous pressure (around +8mmHg is a good target) and to infuse the dobutamine or adrenaline centrally.

Once 60 mL/kg have been given in total, further fluid is unlikely to be beneficial unless skilled ventilation is available.

In this situation, provided there are adequate facilities and expertise, positive pressure ventilation through an endotracheal tube (usually with PEEP) can assist the circulation and help to manage the effects of any pulmonary oedema.

Reviewing FBC and biochemistry

- Blood tests were taken at the beginning of treatment, but it is useful to check the blood tests again (taking the blood from a vein with no IV in place).
- Check the Hb to see if there is now a need for a blood transfusion (fresh blood would be best). Studies have shown that the Hb should ideally be above 10 g/dL when treating shock in children.
- Check blood glucose and treat with 2 mL/kg of 10% dextrose in a neonate and 5 mL/kg of 10% dextrose in an older infant or child if the level is less than 2.5 mmol: also add glucose to any infusion fluid.
- Check calcium and if the level of ionised calcium is less than 1 mmol/L then give 0.3 mg/kg of 10% calcium gluconate IV slowly (over 30 minutes, calcium can cause cardiac arrest if given too quickly).
- Consider giving 0.5 to 1 mmol/kg of sodium bicarbonate (0.5 to 1 mL/kg of 8.4% sodium bicarbonate) over 15 minutes IV for refractory acidosis not responding to fluid resuscitation and effective ventilation.

Steroids

There is some evidence that IV steroids can be helpful in some cases of septic shock. If the suspected organism is meningococcus or the child has previously been on a prolonged course of steroid treatment (for example with nephrotic syndrome) then IV hydrocortisone can be given at a dose of 1-2 mg/kg/day in divided doses or as a continuous infusion. Occasionally higher doses up to 50 mg/kg/day have been used.

Further treatment

Many children with septic shock may respond to the above treatments. For those who have not done so, paediatric intensive or high dependency care is needed. If this is available, then contact should be made with the PICU team as soon as it becomes clear that the child has septic shock. Advice on the care can then be given from experts and arrangements made, if possible, for the child to be 'retrieved' by the intensive care team coming to stabilise and transfer the child.

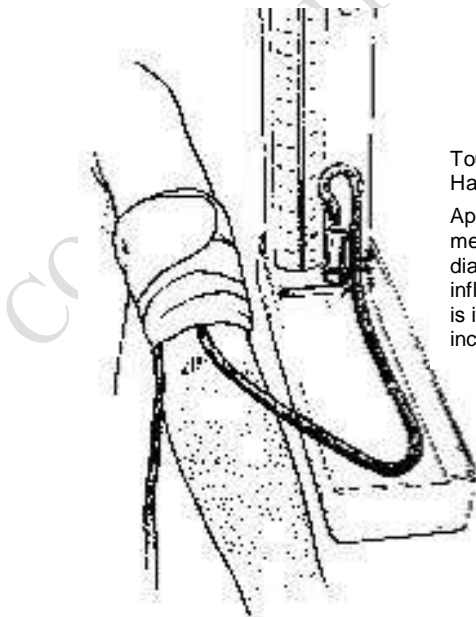
Dengue Haemorrhagic Fever

Dengue fever affects older children and young adults. It is characterised by a biphasic fever with headache, muscle and joint pains, rashes and a low white cell count. It is usually benign but can be incapacitating with severe muscle and joint pain – known as ‘break-bone fever’. Occasionally it is associated with severe haemorrhage – Dengue haemorrhagic fever. This is an emergency and can progress to untreatable shock

Clotting disorders are monitored by serial measurement of platelets and APTT if available (or by measuring the whole blood clotting time).

Grading of Severity of Dengue Haemorrhagic Fever		
Grade	Features	Management
1	Fever; general malaise; positive tourniquet test	Antipyretics; analgesics; oral fluids – avoid NSAIDs
2	Spontaneous bleeding in skin ± other haemorrhage	As above plus IV fluids if needed
3	Evidence of shock; weak pulse, low BP; rising haematocrit	IV fluid resuscitation with Ringer-Lactate or Hartmann's
4	Profound shock with undetectable BP or peripheral pulse	Careful fluid resuscitation with colloid if available. May need blood transfusion and correction of clotting disorder

Treat Dengue fever with shock along the lines of the common care pathway for shock, but be careful not to fluid overload. If fluid overload occurs, treat with frusemide 1mg/kg IV and repeat as necessary.



Tourniquet test in Dengue Haemorrhagic Fever

Apply BP cuff inflated to level of mean arterial pressure (systolic + diastolic, divided by 2). Leave inflated for 5 minutes; a positive test is if there are ≥10 petechiae in 1 sq inch after the cuff is removed

Cardiogenic shock

Causes

- **Abnormal pulse rate or rhythm**
- Congenital cardiac abnormality
- Cardiomyopathy

Abnormal pulse rate or rhythm - Presentation

- History of palpitations
- Poor feeding
- Heart failure or shock
- Episodes of loss of consciousness

When a child presents in shock or imminent cardiac failure due to an abnormal pulse, the treatment priorities are to secure the airway and breathing, and provide oxygen.

Treatment of the rhythm will depend on a few simple criteria

Assessment

- Is the child stable or in shock?
- Is the rate too fast or too slow?
- Is the pulse regular or irregular?
- If there is an ECG, are the QRS complexes wide or narrow?
- Is there a non-cardiac cause of the problem?

Emergency treatment

- Airway Secure the airway with simple opening manoeuvres and adjuncts as necessary
- Breathing High flow oxygen. Assisted ventilation will be needed if the child is shocked
- Circulation
 - Heart rate < 60
 - start chest compressions and vigorous resuscitation
 - ensure adequate oxygenation
 - give a bolus of fluid 20ml/kg IV or IO
 - try atropine 20mcg/kg and adrenaline 10mcg/kg
 - if organophosphate poisoning, give atropine 50-100mcg/kg IV or IM
 - If heart rate 150 - 180 (up to 220 in infant) no ECG and no history of cardiac disease or exposure to drugs causing VT, presume the child has SVT.
 - If ECG shows SVT (or no ECG available)
 - Apply vagal manoeuvres (ice pack on face; valsalva; firm carotid massage)
 - If shocked and access to defibrillator give 0.5, 1 and 2 joules
 - If not shocked or no defibrillator, give IV adenosine 50mcg/kg; followed by 100mcg/kg and 250mcg/kg as necessary
 - If no adenosine or defibrillator, try digoxin
 - If ECG shows VT and the child is shocked
 - Cardiovert with 0.5, 1 then 2joules/kg as needed
 - If no defibrillator, give amiodarone 5mg/kg over 30 mins
 - If no other options available
 - treat hyperkalaemia with calcium gluconate and glucose plus insulin
 - give magnesium sulfate (25-50mg/kg) over a few minutes
 - If poisoning with Tricyclic antidepressants
 - treat with sodium bicarbonate 1mmol/kg followed by phenytoin 15mg/kg over 15 minutes if no improvement

After Resuscitation and Emergency Treatment

After emergency treatment of shock a search should be made for organ damage so that appropriate treatment may be given eg.renal function.

The infant or child with acute renal failure

Introduction

Minimum urine output: >1ml/Kg/hour in children
>2ml/Kg/hour in infants

Types

○ **Pre-renal:**

insult to renal tubule cells from poor perfusion, usually due to shock. This is most commonly associated with gastroenteritis, but must also be thought about in trauma, burns, sepsis and heart failure.

○ **Renal:**

usually due to the same problem causing pre-renal failure, but is more serious. Other causes include poisoning by drugs eg gentamycin, end stage glomerular diseases and haemolytic-uraemic syndrome.

○ **Post renal:**

Acute complete obstruction is rare. Causes include a stone obstructing urethra.

Diagnosis and initial management of ARF

	Pre-renal Failure	Renal Failure
Urine Na+ mmol/l	<10	>10
Urine osmolality ÷ plasma osmolality	>1.5	<1.5
FENa	<1%	>2% **
Microscopy of Urine	no casts	granular/red cell casts

(**Fractional excretion of sodium is the diagnostic test for discriminating between pre-renal and renal failure)

Pre-renal acute renal failure

○ **Clinical diagnosis** reflects **features of shock**

- usually low BP. However, BP may be unexpectedly high because of powerful renin drive in response to hypovolaemia.
- abdominal pain (induced by splanchnic ischaemia as blood flow diverted from gut to more vital organs).

○ **Laboratory diagnosis** by measuring fractional excretion of sodium (**FENa**). Measure the sodium and creatinine in a simultaneously obtained sample of urine and blood.

FENa (%) = U/P sodium x P/U creatinine x 100

- If FENa <1% , renal tubule cells are still alive, and able to respond to shock by reabsorbing sodium which confirms a diagnosis of pre-renal failure. No other tests, including measurements of osmolality, of urinary Na concentration alone, nor urine microscopy can reliably differentiate pre-renal from established renal failure. Ultrasound looks normal or echo-bright.

Section 15 Paediatric emergencies: shock, acute renal failure

- **Treatment is by urgent rehydration.** Give 20 ml/kg as rapidly as possible initially, and repeat if necessary. Thereafter give Ringer-Lactate or Hartmann's to fully correct the fluid deficit within 2 to 4 hours. The deficit can be estimated by multiplying the child's weight by the estimated percentage **dehydration**.
- Once rehydration has started give frusemide 2 mg/kg orally or IV.
- If blood pressure remains markedly depressed after rehydration, it may be due to cardiogenic shock; consider inotropes (if available).

Established acute renal failure

- Laboratory diagnosis FENa is typically > 2% because damaged tubules unable to reabsorb sodium avidly.
- Fluid repletion and frusemide will not result in recovery of renal function.
- If FENa not available, give trial of frusemide (2mg/Kg IV) and consider a fluid challenge if evidence of dehydration
- If not dehydrated (or after correction of dehydration) carefully maintain fluid and electrolyte balance and nutrition while waiting/hoping for recovery.
- Dialysis may be needed (if available).
- If recovery not started by 4 weeks, it is unlikely.

Post-renal ARF

- All cause severe acute colicky abdominal pain: unilateral with ureteric obstruction, or lower abdominal with bladder neck obstruction.
- Ultrasound, if available, will reveal stones and dilatation proximal to obstruction.
- Remove or bypass the obstruction. For a bladder neck stone obstruction, catheterise. Pain relief with an opiate and a muscle relaxant may allow time for an obstructing stone in the ureter to pass, or for the intermittent blockage from a pelviureteric junction narrowing to clear. If not, stone removed cystoscopically or by ureterolithotomy, or the upper renal tract drained by insertion of a percutaneous nephrostomy under ultrasound guidance. This may require transfer to another centre

Ongoing management of persistent ARF

Good general care:

Meticulous fluid balance:

- Accurately measure all intake and losses. For babies, stool and urine losses estimated by weighing clean and dirty nappies.
- Insensible water losses: (see appendix for table of estimate of body surface area)
 - **300ml/m²/24 hours or**
 - 12ml/Kg/24 hours if > 1 year
 - 15ml/Kg/24 hours if an infant
 - 24ml/Kg/24 hours if a preterm infant
- Increased in hot climate by around 50%.
- Best guide is to weigh twice daily.
- Adequate nutrition is important but difficult to provide. Aim to provide normal calorie intake from carbohydrates and fats
- limit protein intake to about 1 g/kg/day to minimise uraemia.
- Young infants who normally take milk, and children too ill to eat solid food, or with gastrointestinal involvement, will need NG feeding or IV nutrition
- nutrition may have to be delivered in a large fluid volume.
- If there is polyuric renal failure or high non-renal water losses such as from diarrhoea or drain fluids this can be achieved.

Section 15 Paediatric emergencies: shock, acute renal failure

- if oligoanuric, it is not possible to give sufficient nutrition without fluid overload leading to hypertension and pulmonary oedema.
- Concentrated fat-based oral feeds can be made up from double cream.
- sophisticated IV fluids with high glucose content and individually adjusted sodium (and bicarbonate) concentrations, tailored to balance losses are usually only available in well resourced settings.

Usually necessary to limit salt intake to prevent sodium retention with hypernatraemia, leading to insatiable thirst, and fluid overload.

Provide some bicarbonate to prevent acidosis, typically at a starting dose of 1 mmol/kg/day sodium bicarbonate (note, 1 ml of an 8.4% sodium bicarbonate solution contains 1 mmol, and 1 g of powder contains 12 mmol)

Dietary potassium must be restricted to avoid hyperkalaemia. Hyperkalaemia causes arrhythmias, especially in ARF where other metabolic changes may exacerbate the risk (for example, hypocalcaemia). Aim to keep plasma potassium < 6.5 mmol/L in an older child and < 7.0 mmol/L in neonates who tolerate hyperkalaemia better.

Dietary phosphate restricted to prevent hyperphosphataemia. Giving calcium carbonate with the food (eg, 0.5 to 2 grams with each meal) will bind the intestinal phosphate and reduce hyperphosphataemia as well as improving the tendency to hypocalcaemia.

Blood pressure monitoring and anti-hypertensives may be needed

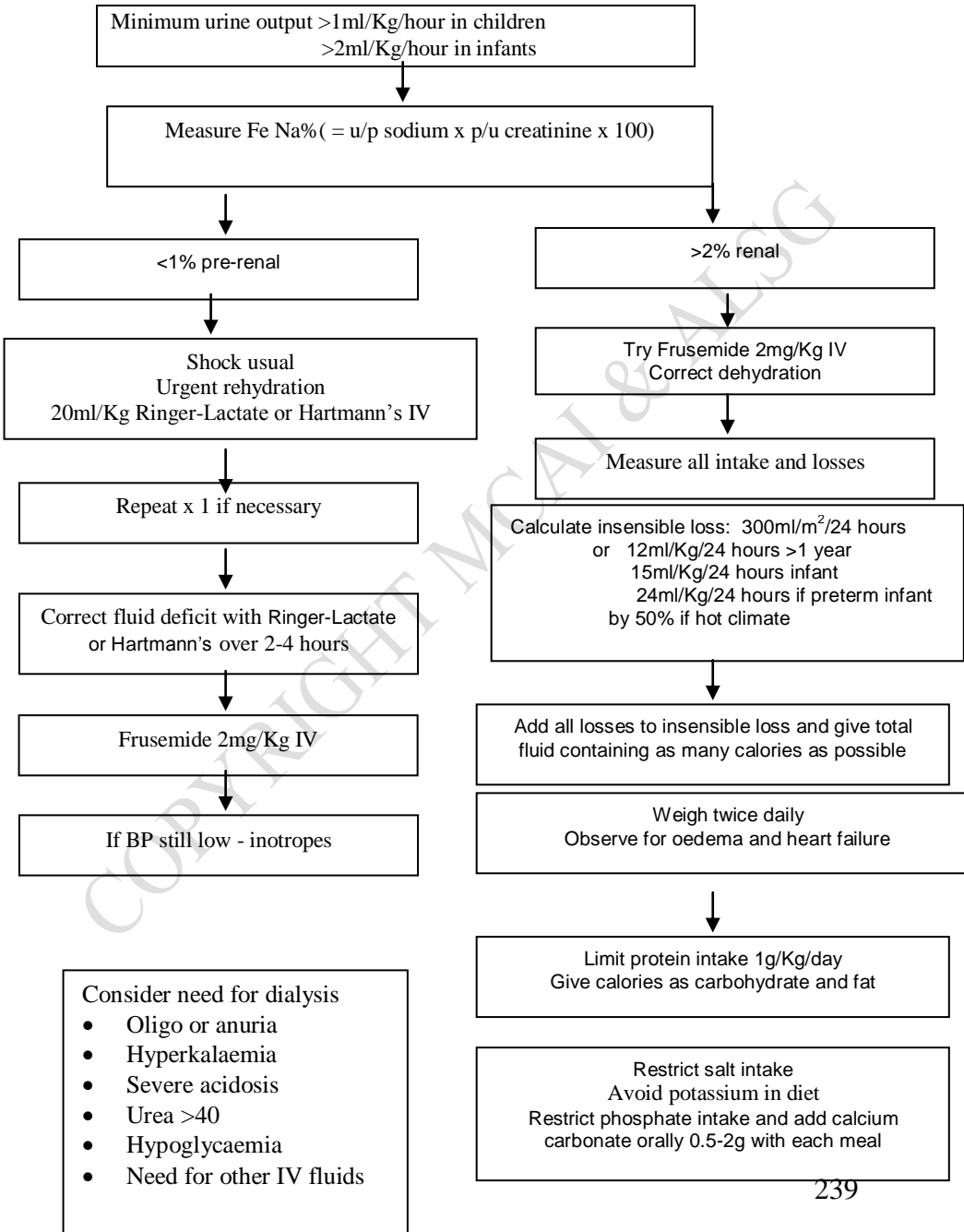
Many drug dosages will need adjustment as they are renally excreted

Peritoneal dialysis

This is indicated if

- oligoanuria persists
- hyperkalaemia occurs (the commonest indication)
- severe metabolic acidosis. Treatment with sodium bicarbonate is limited because this may lead to massive sodium overload, and hence to dangerous levels of hypernatraemia, and to greater fluid retention.
- hypoglycaemia occurs and needs IV glucose solutions
- other fluids are required such as platelets.
- urea rises > 40 mmol/L causing clinical uraemia

Pathway of care Acute Renal Failure in a child



The Infant or Child in Coma

Coma may be the presentation of many illnesses. It is unusual for children to have a structural problem so the cause of coma is most likely to be a diffuse metabolic or infective process, or to be associated with trauma.

Causes of coma
• Hypoglycaemia
• Malaria
• Meningitis (including TB)
• Head injury –see trauma section
• HIV
• Drugs / poisons
• Post convulsion

Primary assessment

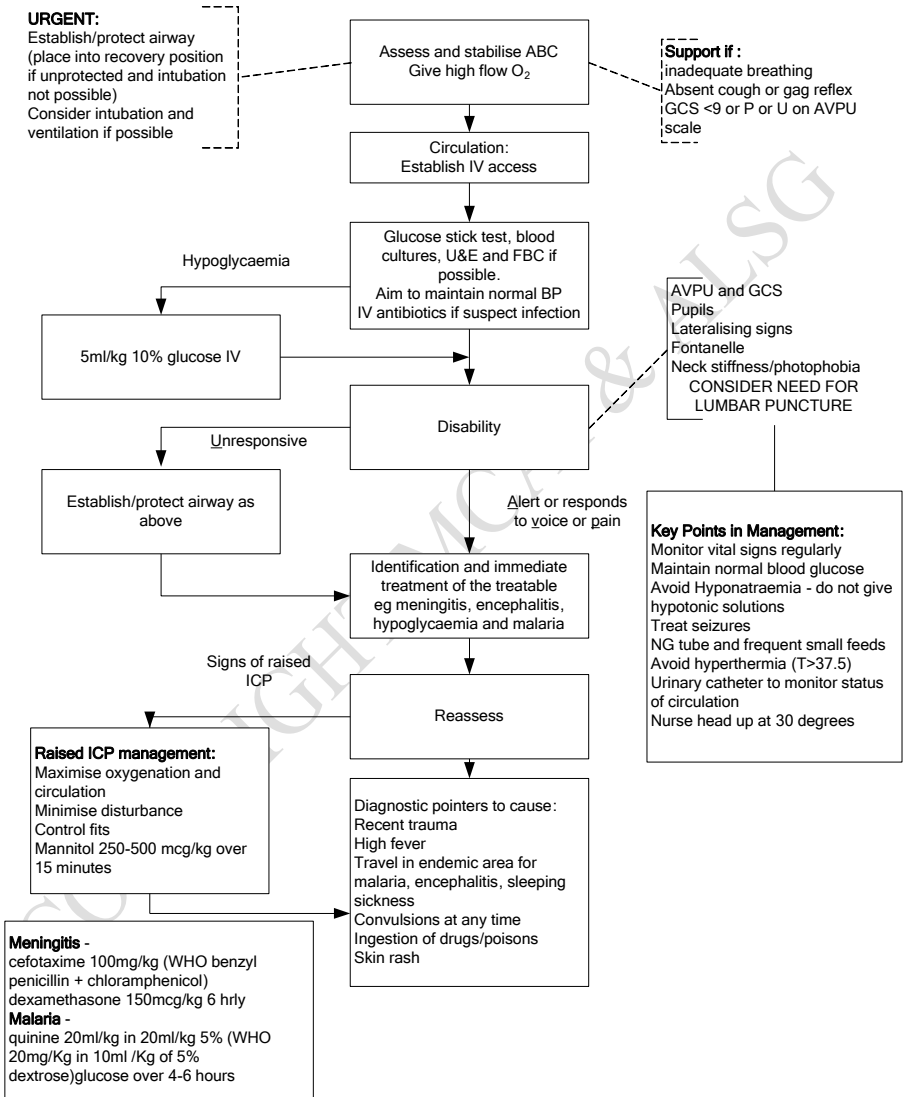
The first steps in managing a child with an altered level of consciousness are to assess and, if necessary, support Airway, Breathing and Circulation.

- **Airway** – this is at risk if the child scores ‘P’ or ‘U’ on the AVPU scale
- **Breathing** – this may be the cause of coma, by inadequate oxygenation or increasing CO₂; or be compromised by coma with centrally driven hypoventilation.
- **Circulation** – hypotension leads to under-perfusion of the brain. In late stages of raised intracranial pressure, the child becomes hypertensive. The body responds by reducing heart rate. Hypertension and bradycardia are very serious signs.
- **Disability**
 - Assess using AVPU score
 - Check blood glucose
 - Check pupils for size, equality and reaction to light
 - Palpate fontanelle for signs of raised ICP

A more formal assessment may be made using the Glasgow Coma Scale (GCS)

Pupillary changes	
Pupil size & reactivity	Causes
Small, reactive	Metabolic disorder Medullary lesion
Pin-point	Metabolic disorder Narcotics /orgnophosphates
Fixed, dilated	Hypothermia Hypoxic / ischaemic brain During and post seizure Anticholinergics / barbiturates
One fixed. dilated pupil	Ipsilateral lesion Tentorial; herniation III cranial nerve lesion Epileptic seizure

Pathway of Care for Child in Coma



Specific conditions

1. Meningitis or encephalitis (after the neonatal period)

The three common organisms causing meningitis are

- *Neisseria meningitidis* which has a high mortality and morbidity;
- *Haemophilus influenzae* which is much less common in areas with immunisation programmes
- *Streptococcus pneumoniae* which is more commonly seen in disadvantaged countries and in immunocompromised patients
- *Gram negative organisms such as Ecoli* in neonates

Classic signs might be absent in a small child. A bulging fontanelle is a clear sign of intracranial infection, but may be masked by associated dehydration. Meningitis is almost always associated with raised ICP, so the symptoms and signs are related to this.

Diagnosis in a child ≤ 3 yrs old

- Reduced level of consciousness
- Irritability
- Poor feeding or vomiting
- Fever with no apparent cause
- Convulsions with or without fever
- Apnoeic or cyanotic episodes
- Purpuric rash
- Recent head injury

Diagnosis in a child ≥ 4 years old

- Headache or neck pain
- Vomiting
- Neck stiffness
- Opisthotonus
- Photophobia
- Rash
- Altered level of consciousness
- Recent head injury

Early diagnosis is essential for effective treatment.

There is a risk of coning if an LP is performed in a child with raised ICP

.Laboratory investigations

If possible, confirm the diagnosis with a lumbar puncture and examination of the CSF. If the CSF is cloudy, assume meningitis and start treatment while waiting for laboratory confirmation. Microscopy should indicate the presence of meningitis in the majority of cases with the white cell (polymorph) count above 100/mm³. Confirmatory information can be gained from the CSF glucose (low: <1.5 mmol/litre), CSF protein (high: >0.4 g/litre), and Gram staining and culture of the CSF, where possible.

During a confirmed epidemic of meningococcal meningitis it is not necessary to perform a lumbar puncture on children who have petechial or purpuric signs, which are characteristic of meningococcal infection. During such epidemics, give oily chloramphenicol (100 mg/kg IM as a single dose up to a maximum of 3 grams) for the treatment of meningococcal meningitis.

Section 15 Paediatric emergencies: meningitis

The oily suspension is thick and may be difficult to push through the needle. If this problem is encountered, the dose can be divided into two parts and an injection given into each buttock of the child.

Consider tuberculous meningitis if:

- fever persists for 14 days
- fever persists for more than 7 days and there is a family member with tuberculosis
 - a chest X-ray suggests tuberculosis
 - the patient remains unconscious
 - CSF continues to have moderately high white blood cell counts (typically, <500 white cells per ml, mostly lymphocytes), elevated protein levels (0.8–4 g/l) and low glucose levels (<1.5 mmol/litre).

In children known or suspected to be HIV-positive, tuberculous or cryptococcal meningitis should also be considered. For diagnosis of cryptococcus, do a CSF stain with India ink.

Treatment

If the CSF is obviously cloudy, treat immediately with antibiotics before the results of laboratory CSF examination are available. If the child has signs of meningitis and a lumbar puncture is not possible, treat immediately.

Antibiotic treatment

Give antibiotic treatment as soon as possible. Choose one of the following two regimens:

1. Chloramphenicol: 25 mg/kg IM (or IV) every 6 hours plus ampicillin: 50 mg/kg IM (or IV) every 6 hours

OR

2. Chloramphenicol: 25 mg/kg IM (or IV) every 6 hours plus benzylpenicillin: 60 mg/kg (100 000 units/kg) every 6 hours IM (or IV).

Where there is known significant drug resistance of common pathogens (e.g. *Haemophilus influenzae* or *Pneumococcus*) to these antibiotics, follow the national guidelines. In many circumstances, the most appropriate treatment will be a third-generation cephalosporin such as:

- ceftriaxone: 50 mg/kg IM/IV, over 30–60 minutes every 12 hours; or 100 mg/kg IM/IV, over 30–60 minutes once daily; or 1 month–12 years: 50–80 mg/kg OD, 12–18 years: 1g, up to 2–4g in severe infections
- cefotaxime: 50 mg/kg IM or IV, every 6 hours.

Review therapy when CSF results are available. If the diagnosis is confirmed, give treatment parenterally for at least 5 days. Once the child has improved, give chloramphenicol orally unless there is concern about oral absorption (e.g. in severely malnourished children or in those with diarrhoea), in which cases the full treatment should be given parenterally. The total duration of treatment is 10 days.

If there is a poor response to treatment:

- Consider the presence of common complications, such as subdural effusions (persistent fever plus focal neurological signs or reduced level of consciousness) or a cerebral abscess. If these are suspected, refer the child to a central hospital with specialized facilities for further management
- Look for other sites of infection which may be the cause of fever, such as cellulitis at injection sites, arthritis, urinary tract infection or osteomyelitis.

Section 15 Paediatric emergencies: meningitis

-Repeat the lumbar puncture after 3–5 days if the fever is still present and the child's overall condition is not improving, and look for evidence of improvement (e.g. fall in leukocyte count and rise in glucose level).

Steroid treatment

There is not sufficient evidence to recommend routine use of dexamethasone in all children with bacterial meningitis in poorly resourced countries.

Do not use steroids in:

- newborns
- suspected cerebral malaria
- suspected viral encephalitis
- areas with a high prevalence of penicillin-resistant pneumococcal invasive disease.

TB meningitis

Consider tuberculous meningitis if:

- fever persists for 14 days
- fever persists for more than 7 days and there is a family member with tuberculosis
- a chest X-ray suggests tuberculosis
- the patient remains unconscious
- CSF continues to have moderately high white blood cell counts (typically,

<500 white cells per ml, mostly lymphocytes), elevated protein levels (0.8–4 g/l) and low glucose levels (<1.5 mmol/litre).

In children known or suspected to be HIV-positive, tuberculous or cryptococcal meningitis should also be considered. For diagnosis of cryptococcus, do a CSF stain with India ink.

Consult national tuberculosis programme guidelines if TBM is found or strongly suspected.

The optimal treatment regimen, where there is no drug resistance, comprises:

- isoniazid (10 mg/kg, max 300mg) for 6–9 months; and
- rifampicin (15–20 mg/kg, max 600mg) for 6–9 months; and
- pyrazinamide (35 mg/kg max 2g) for the first 2 months.

Dexamethasone (0.6 mg/kg/day for 2–3 weeks, tailing the dose over a further 2–3 weeks) should be given to all cases of tuberculous meningitis.

Antimalarial treatment

In malarial areas, take a blood smear to check for malaria since cerebral malaria should be considered as a differential diagnosis or co-existing condition. Treat with an antimalarial if malaria is diagnosed. If for any reason a blood smear is not possible, treat presumptively with an antimalarial drug.

Supportive care

Examine all children with convulsions for hyperpyrexia and hypoglycaemia. Treat the hypoglycaemia. Control high fever ($\geq 39^\circ\text{C}$ or $\geq 102.2^\circ\text{F}$) with paracetamol.

In an unconscious child:

- Maintain a clear airway.
- Nurse the child on the side to avoid aspiration of fluids.
- Turn the patient every 2 hours.

Section 15 Paediatric emergencies: meningitis

- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.
- Monitor for signs raised intracranial pressure Give mannitol 250-500mg/kg if deteriorating

Oxygen treatment

Oxygen is not indicated unless the child has convulsions or associated severe pneumonia with hypoxia (SaO₂ <90%) (EMCH <94%), or, if you cannot do pulse oximetry, cyanosis, severe lower chest wall in-drawing, respiratory rate of >70/minute.

Fluid and nutritional management

There is no good evidence to support fluid restriction in children with bacterial meningitis. Give them their daily fluid requirement, but not more because of the risk of cerebral oedema. Monitor IV fluids very carefully and examine frequently for signs of fluid overload. Provide food as soon as it is safe. Breastfeed every 3 hours, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If there is a risk of aspiration, give the sugar solution by nasogastric tube. Continue to monitor the blood glucose level and treat accordingly (as above), if found to be <2.5 mmol/ litre or <45 mg/dl.

Complications

Convulsions

If convulsions occur, give anticonvulsant treatment.

Hypoglycaemia

Give 5 ml/kg of 10% glucose solution IV rapidly Recheck the blood glucose in 30 minutes and if the level is low (<2.5 mmol/litre or <45 mg/dl), give further dose of glucose solution. Prevent further hypoglycaemia by feeding, where possible (see above). If you give IV fluids, prevent hypoglycaemia by adding 10 ml of 50% glucose to 90 ml of Ringer-Lactate or Hartmann's. Do not exceed maintenance fluid requirements for the child's weight. If the child develops signs of fluid overload, stop the infusion and repeat the 10% glucose bolus (5 ml/kg) at regular intervals.

2. Malaria

Features

- There are no pathognomic signs; fever in an endemic area is malaria until proven otherwise
- Typical features include high swinging fever, chills, rigors, sweating, myalgia, arthralgia, headache, lethargy, cough, nausea, vomiting and diarrhea
- In infants the only findings may be fever and failure to feed properly (malaria is very rare in < 2/12 old because of the protective effect of HbF)
- Severe disease may cause altered level of consciousness, fits, severe anaemia and jaundice
- Cerebral malaria is associated with raised ICP and rapid onset coma
- Malaria may be accompanied by non-typhoid salmonellosis or meningitis

Signs of severe malaria

- Altered conscious level
- Convulsions
- Severe anaemia
- Acidosis
- Hypoglycaemia
- Hyperpyrexia
- Pulmonary oedema- uncommon in children
- Renal failure
- Jaundice
- DIC

Cerebral malaria

- Plasmodium falciparum
- Altered level of consciousness
- Commonest cause coma in age 1-5 in endemic areas
- Convulsions, severe anaemia, hypoglycaemia, hyperpyrexia and acidosis are common
- Signs of raised ICP
- Other causes of coma such as 245 meningitis should be sought

Diagnosis

Investigations (if available)	
Investigation	Findings
Thick & thin blood films	Thick confirms diagnosis; thin identifies species
FBC and sickle test	Anaemia; sickle disease / trait
Blood glucose	Hypoglycaemia
U&E	Effect of vomiting / diarrhoea
Group & save	? need transfusion
Urinalysis	UTI, haemoglobinurea (may cause renal failure)
Lumbar puncture – not if signs of raised ICP. However, if suspect RICEP assume meningitis is present and give antibiotics IV.	?meningitis
CXR	? pneumonia / pulmonary oedema
Blood gases	Monitor acid / base status

Management**Airway & Breathing**

- Assess and provide support as needed. Protect airway if altered level of consciousness. Consider NGT to prevent aspiration
- High flow oxygen
- Check for acidotic breathing

Circulation

- IV or IO access; if not possible, or risk of fluid overload, use NGT
- Treat hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) with 5ml/kg 10% glucose (via NGT if no IV access)
 - Recheck glucose after 30 mins and repeat if needed
- Treat severe anaemia – Hb < 5g/dl; or haematocrit < 15%; or evidence cardiac failure
 - Packed cells 10ml/kg or whole blood 20ml/kg over 3-4 hours
 - If severely malnourished there is a risk of overload; if occurs treat with frusemide 1-2mg/kg
- If acidosis (or acidotic breathing in absence of blood gas analysis) give extra fluids
- Monitor urine output and aim for 1ml/kg/hr. Rehydrate to maintain output; consider use of frusemide if unable to achieve 4ml/kg/24hrs
- Shock is unusual in malaria – if present treat with fluid bolus 20ml/kg. Take blood cultures and start broad spectrum antibiotics in addition to anti-malarial treatment

Disability

- Treat convulsions
- Consider lumbar puncture but avoid if V, P or U on AVPU (GCS <13); signs raised ICP or papilloedema (treat for meningitis as well if these signs are present)
- Consider other causes of coma

Section 15 Paediatric emergencies: malaria

- Avoid or treat hyperpyrexia ($T > 39$, or > 38 if cerebral malaria) – use tepid sponging, fanning and oral / rectal Paracetamol 20mg/kg

Malarial treatment

IV artesunate is the first line drug. Give 2.4 mg/kg IV or IM on admission, followed by 1.2 mg/ kg IV or IM after 12 hours, then daily for a minimum of 3 days until the child can take oral treatment of another effective antimalarial.

An alternative is:

IM artemether. Give 3.2 mg/kg IM on the first day, followed by 1.6 mg/kg IM daily for a minimum of 3 days until the child can take oral treatment. Use a 1 ml tuberculin syringe to give the small injection volume.

Complete treatment in severe malaria following parenteral artesunate or artemether administration by giving a full course of artemisinin-based combination therapy or oral quinine to complete 7 days of treatment. If available and affordable, quinine should be combined with clindamycin.

IV quinine is a drug that can be used if artesunate or artemether is not available – **never give it as a bolus**

Use quinine dihydrochloride salt.

- 20mg/kg in 20ml/kg 5% dextrose over 4-6 hours (WHO = 20mg/Kg quinine in 10ml/Kg 5% dextrose over 4-6 hours).
- Must not be given too quickly because of serious cardiac effects
- If there is a risk to IV, give 10mg/kg IM (diluted in 0.9% saline to give concentration of 60mg salt/ml to aid absorption and is less painful) followed by 10mg/kg IM at 4 hours
- Subsequent dose given 8 hours following start of loading dose of 10mg/kg over 4 hours, every 12 hours until child able to take oral treatment (WHO 10mg/Kg over 2 hours repeated 8 hourly)
- Change to oral medication as soon as possible and give 10mg/kg every 8 hours for 7 days

Supportive care

As for care of severe malaria

Specific precautions during rehydration

- Check for dehydration and treat appropriately.
- During re-hydration, examine frequently for signs of fluid overload. The most reliable sign is an enlarged liver. Additional signs are gallop rhythm, fine crackles at lung bases and/or fullness of neck veins when upright. Eyelid oedema is a useful sign in infants.
- If, after careful re-hydration, the urine output over 24 hours is less than 4 ml/kg body weight, give IV frusemide, initially at 2 mg/kg body weight. If there is no response, double the dose at hourly intervals to a maximum of 8 mg/kg body weight (given over 15 minutes).
- In children with no dehydration, ensure that they receive their daily fluid requirements but take care not to exceed the recommended limits Be particularly careful in monitoring IV fluids.

Complications

Coma (cerebral malaria)

Section 15 Paediatric emergencies: malaria

- Assess the level of consciousness according to the AVPU or another locally used coma scale for children
 - Give meticulous nursing care and pay careful attention to the airway, eyes, mucosae, skin and fluid requirements.
 - Exclude other treatable causes of coma (e.g. hypoglycaemia, bacterial meningitis).
- Perform a lumbar puncture **if there are no signs of raised intracranial pressure**. If you cannot do a lumbar puncture and cannot exclude meningitis, give antibiotics as for bacterial meningitis.

Convulsions

These are common before and after the onset of coma. When convulsions are present, give anticonvulsant treatment.

Correct any possible contributing cause such as hypoglycaemia or very high fever. If there are repeated convulsions, give phenobarbital.

Shock

Some children may have a cold, clammy skin. If there are signs of shock (cold extremities, weak pulse, capillary refill longer than 3 seconds) these features are not usually due to malaria alone. Suspect an additional bacteraemia and give both an antimalarial and antibiotic treatment, as for septicæmia.

Severe anaemia

This is indicated by severe palmar pallor, often with a fast pulse rate, difficult breathing, confusion or restlessness. Signs of heart failure such as gallop rhythm, enlarged liver and, rarely, pulmonary oedema (fast breathing, fine basal crackles on auscultation) may be present.

Give a **blood transfusion** as soon as possible to:

- all children with a haematocrit of $\leq 12\%$ or Hb of ≤ 4 g/dl
- less severely anaemic children (haematocrit $> 12\text{--}15\%$; Hb 4–5 g/dl) with any of the following:
 - clinically detectable dehydration
 - shock
 - impaired consciousness
 - deep and laboured breathing
 - heart failure
 - very high parasitaemia ($> 10\%$ of red cells parasitized).

Give packed cells (10 ml/kg body weight), if available, over 3–4 hours in preference to whole blood. If not available, give fresh whole blood (20 ml/kg body weight) over 3–4 hours.

A diuretic is not usually indicated because many of these children have a low blood volume (hypovolaemia).

Check the respiratory rate and pulse rate every 15 minutes. If one of them rises, transfuse more slowly. If there is any evidence of fluid overload due to the blood transfusion, give IV frusemide (1–2 mg/kg body weight) up to a maximum total of 20 mg.

After the transfusion, if the Hb remains low, repeat the transfusion.

In severely malnourished children, fluid overload is a common and serious complication.

Give whole blood (10 ml/kg body weight rather than 20 ml/kg) once only and do not repeat the transfusion.

Hypoglycaemia

Section 15 Paediatric emergencies: malaria

Hypoglycaemia (blood glucose: <2.5 mmol/litre or <45 mg/dl) is particularly common in children under 3 years old, in children with convulsions or hyperparasitaemia, and in comatose patients. ***It is easily overlooked because clinical signs may mimic cerebral malaria.***

Give 5 ml/kg of 10% glucose solution IV rapidly. Recheck the blood glucose in 30 minutes, and repeat the glucose (5 ml/kg) if the level is low (<2.5 mmol/litre or <45 mg/dl). Prevent further hypoglycaemia in an unconscious child by giving 10% glucose infusion (add 10 ml of 50% glucose to 90 ml of a 5% glucose solution, or 10 ml of 50% glucose to 40 ml of sterile water). Do not exceed maintenance fluid requirements for the child's weight. If the child develops signs of fluid overload, stop the infusion; repeat the 10% glucose (5 ml/kg) at regular intervals.

Once the child is conscious, stop IV treatment. Feed the child as soon as it is possible. Breastfeed every 3 hours, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If not able to feed without risk of aspiration, give sugar solution by nasogastric tube. Continue to monitor the blood glucose level, and treat accordingly (as above) if found to be <2.5 mmol/litre or <45 mg/dl.

Respiratory distress (acidosis)

This presents with deep, laboured breathing while the chest is clear— sometimes accompanied by lower chest wall in-drawing. It is caused by systemic metabolic acidosis (frequently lactic acidosis) and may develop in a fully conscious child, but more often in children with cerebral malaria or severe anaemia.

Correct reversible causes of acidosis, especially dehydration and severe anaemia.

— If Hb is ≥ 5 g/dl, give 20 ml/kg of Ringer-Lactate or Hartmann's IV over 30 minutes.

— If Hb is <5 g/dl, give whole blood (10 ml/kg) over 30 minutes, and a further 10 ml/kg over 1–2 hours without diuretics. Check the respiratory rate and pulse rate every 15 minutes. If either of these shows any rise, transfuse more slowly to avoid precipitating pulmonary oedema.

Aspiration pneumonia

Treat aspiration pneumonia immediately because it can be fatal. Place the child on his/her side. Give IM or IV chloramphenicol (25 mg/kg every 8 hours) until the child can take this orally, for a total of 7 days. Give oxygen if the SaO₂ is $<90\%$ ($<94\%$ EMCH), or, if you cannot do pulse oximetry, there is cyanosis, severe lower chest wall in-drawing or a respiratory rate of ≥ 70 /minute.

Monitoring

The child should be checked by nurses at least every 3 hours and by a doctor at least twice a day. The rate of IV infusion should be checked hourly. Children with cold extremities, hypoglycaemia on admission, respiratory distress, and/ or deep coma are at highest risk of death. It is particularly important that these children be kept under very close observation.

Monitor and report immediately any change in the level of consciousness, convulsions, or changes in the child's behaviour.

Monitor the temperature, pulse rate, respiratory rate (and, if possible, blood pressure) every 6 hours, for at least the first 48 hours.

Monitor the blood glucose level every 3 hours until the child is fully conscious.

Section 15 Paediatric emergencies: malaria

Check the rate of IV infusion regularly. If available, use a giving chamber with a volume of 100–150 ml. Be very careful about over-infusion of fluids from a 500 ml or 1 litre bottle or bag, especially if the child is not supervised all the time. Partially empty the IV bottle or bag. If the risk of over-infusion cannot be ruled out, re-hydration using a nasogastric tube may be safer.

Keep a careful record of fluid intake (including IV) and output.

Management of the infant or child with convulsion

Remember, cerebral malaria, meningitis, including TB, HIV, metabolic disorders are common cause of convulsions

Introduction

Convulsive status epilepticus (CSE) is a life threatening condition in which the brain is in a state of prolonged, electrical discharges. It is defined as a generalised convulsion lasting more than 30 minutes or recurrent convulsions which occur very frequently over a 30 minute period where the patient does not regain consciousness in between seizures.

The duration of the convulsion is very relevant as the longer the duration of the episode, the more difficult it becomes to control it. Convulsions that persist beyond 10 minutes are much less likely to stop spontaneously, Hence it is usual practice to institute anticonvulsive treatment when the episode has lasted 5 minutes or more.

Common causes of convulsions in children include:

- fever with a predisposition to febrile convulsions (usually between ages 6 months to 6 years),
- meningitis
- epilepsy
- hypoxia
- metabolic abnormalities.
- abrupt withdrawal of anti-seizure medication, especially phenobarbitone
- acute cerebral event /injury (e.g. haemorrhage or trauma)
- ingestion of medication

Tonic-clonic status occurs in approximately 5% of patients with epilepsy. Up to 5% of children with febrile seizures will present with status epilepticus. The mortality rate of status epilepticus can be high (up to 20% in adults), especially if treatment is not initiated quickly. However with optimal management and adherence to a structured and standardised management plan, the mortality in children is much lower and patients can survive with minimal or no brain damage.

Evaluation and immediate management of status epilepticus

Diagnostic pointers	
Fever	suggestive of infection, but also occurs with ecstasy, cocaine and salicylate poisoning
Hypothermia	associated with ingestion of barbiturates or alcohol
Rash	Purpuric suggestive of meningococcal disease
Bruising	Consider trauma, including non-accidental injury or bleeding disorder
Retinal bleed/bruises/fractures	Suggest subdural bleed; consider child abuse
Urinalysis	If available, check for evidence of poisoning or drug ingestion

Section 15 Paediatric emergencies: convulsions

During a seizure;

- turn the child on their side.
- take an ABC approach. It is vital to ensure satisfactory respiration and circulation and to exclude or treat hypoglycaemia before giving anti-epileptic drugs.
- ensure the airway is patent and there is adequate respiratory effort and circulatory volume. Institute corrective measures immediately if so required.
- if available apply oxygen via a mask.
- check glucose and treat if low < 3.0 mmol/L (54 mg/dL). If in doubt or unable to check, it is safer to treat as if hypoglycaemia is present and give 10 % dextrose IV 5 mL/kg as an initial bolus and, if safe to do so, followed by an infusion containing a glucose containing fluid to avoid the risk of rebound hypoglycaemia.
- if the seizure has lasted more than five minutes (or if the duration is not known) prepare for anticonvulsant treatment. Short recurrent seizures lasting less than 5 minutes should also be treated (see flow chart in figure 5.16.E.1).
- Must have available self inflating bag with non-return valve (e.g. Ambubag) and suitably sized face mask in case of excessive respiratory depression from benzodiazepines.
- treat the fever if present by exposure, tepid sponging and rectal paracetamol (Dose: 40 mg/kg loading dose, 20 mg/kg if <3 months).

Drugs

Lorazepam IV or IO

Lorazepam is a benzodiazepine with a quick onset of action and a longer duration of effect (12–24 hours) compared to diazepam (which is less than one hour). It produces less respiratory depression as compared to other benzodiazepines, is less likely to need additional anticonvulsants to stop the seizure. However absorption from the rectal route is poor. Lorazepam is not available in every country but is no more expensive than diazepam.

Dose: 0.05-0.1mg/kg/dose IV or IO (dose can be repeated)

Midazolam

Midazolam is an effective, quick acting anticonvulsant, which takes effect within minutes but has a shorter lasting effect (15-20 minutes). Most children do not convulse again once the seizure has been terminated.

Buccal midazolam is twice as effective as rectal diazepam, but both drugs produce the same degree of respiratory depression. This occurs only in about 5% of patients, is short lived and is usually easily managed with bag valve mask ventilatory support.

It can be given by the buccal or intravenous routes, however the ready made buccal midazolam may not be available in some countries. In such situations the standard IV preparation can be used instead via the buccal route. Simply draw the required dose in a syringe using a needle so as to filter off any glass fragments and after removing the needle apply the drug on the buccal mucosa between the lower lip and the gum.

Dose: 0.05-0.1mg/kg/dose IV/IO (dose may be repeated)

0.2- 0.5 mg/kg/dose (maximum 10mg) Buccal application (dose may be repeated)

Diazepam

Diazepam is an effective, commonly used, readily available and quick acting anticonvulsant with similar characteristics to midazolam. It is widely used, but may now be superseded by

Section 15 Paediatric emergencies: convulsions

the more effective lorazepam or buccal midazolam where the latter is available. The rectal dose is well absorbed.

Dose: 0.5 mg/kg/dose rectally

0.1-0.2 mg/kg/dose IV or IO (dose may be repeated)

Lorazepam intranasal

This has been found to be safer than IM paraldehyde and is also less expensive and easier to access. It is directly instilled into any one nostril, with the patient in a supine position, drop by drop over 30–60 seconds.

Dose: The same as IV lorazepam above

Paraldehyde

Paraldehyde is an effective and cheap anticonvulsant with a sustained level of effect and a good safety profile, however it may be difficult to find in some countries. Paraldehyde takes 10-15 minutes to commence its effect and its action is sustained for two to four hours.

It is generally given by the rectal route after mixing up the required dose with an equal amount of any edible oil (e.g. olive oil). This mixture is then quickly pushed up the rectum using a simple feeding tube attached to a syringe. Do not leave paraldehyde standing in a plastic syringe for longer than a few minutes as the drug dissolves plastic. The intramuscular route can also be used but is very painful and can lead to abscess formation. This route is better avoided. Paraldehyde causes little respiratory depression. It should not be used in liver disease.

Dose: 0.4 mL/kg rectally (0.4g/kg)

Phenytoin

Phenytoin is a readily available anticonvulsant capable of producing very good results with little effect on respiration. It has a peak action within one hour with a long half life. Its action therefore is more sustained than diazepam.

It is given as an intravenous infusion mixed with 0.9% sodium chloride solution made up to a concentration of 10 mg per mL given over a 20 minute period. Phenytoin can cause dysrhythmias and hypotension (more so if given rapidly), it is therefore important to monitor the electrocardiogram (ECG) and blood pressure (BP) where available. In addition, local irritation, phlebitis, and dizziness may accompany intravenous administration. If the child is known to be on oral phenytoin it is better to either avoid using phenytoin (use phenobarbitone instead) or to use a lower loading dose (i.e. 10 mg/kg).

Dose of phenytoin: 20 mg/kg IV infusion given over 20 minutes (only use normal saline for dilution)

Phenobarbitone

Phenobarbitone is a time tested anticonvulsant and readily available in many countries, and the parenteral preparation is on the WHO essential drug list. It can be used to good effect in all age groups with little respiratory depression. It is given by the intravenous route as a slow injection over 5-15 minutes, and can be given intramuscularly although the absorption is variable. It has a sustained effect lasting over 12-24 hours.

There is now evidence to suggest that phenytoin and phenobarbitone may have some synergistic effect when used sequentially. It is thought that one primes the brain in readiness for the other thus producing a beneficial effect. Controversy, however, surrounds as to which drug should be used first.

Section 15 Paediatric emergencies: convulsions

Dose: 20 mg/kg IV infusion over 5-10 minutes

Thiopental

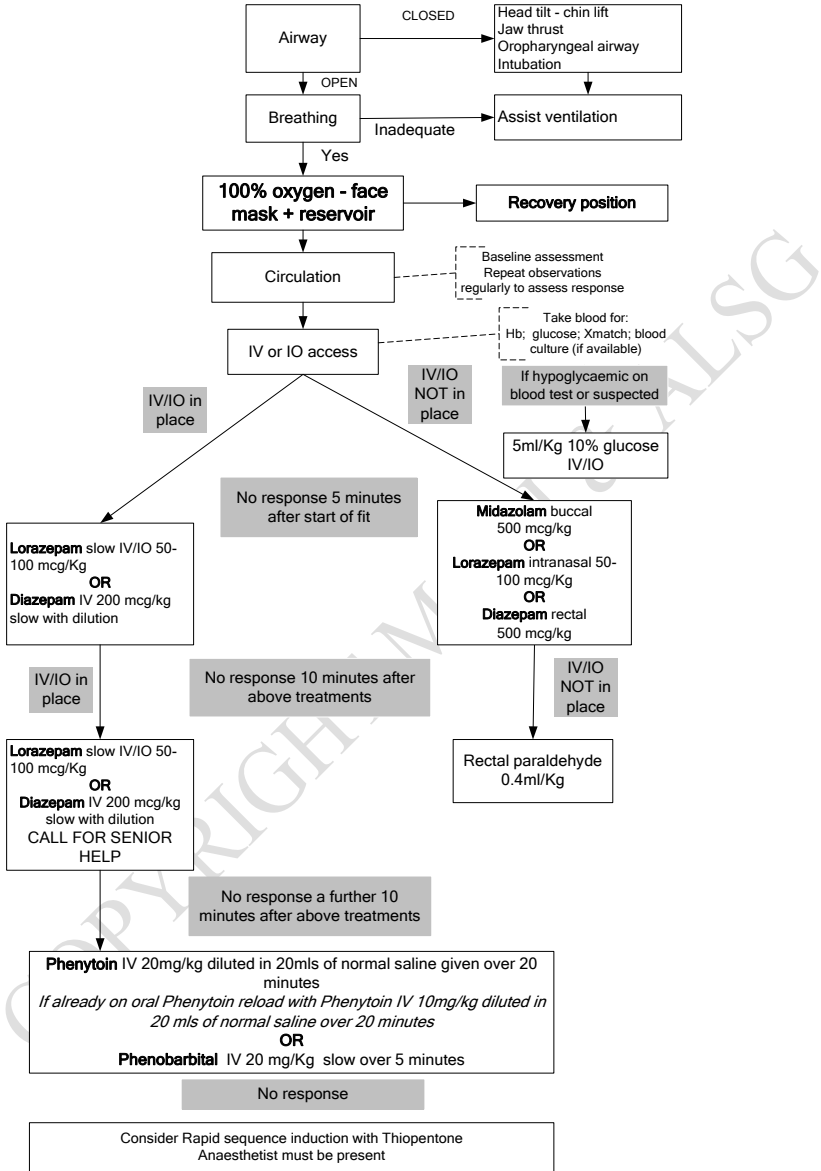
Thiopental (Thiopentone) sodium is a drug better used by experienced staff who are familiar with it (usually anaesthetists) and are capable of intubating difficult cases. It is a general anaesthetic agent with no analgesic properties and marked cardiorespiratory effects. It is usually given after paralysis and intubation in an induction of anaesthesia. Other antiepileptic medication must be continued. The child should not remain paralysed as continued seizure activity cannot otherwise be monitored. A paediatric neurologist should continue to give clinical advice and support.

General measures once seizures are controlled:

- Maintain a normoglycaemic state using 5% glucose containing solutions (10% in young infants). Often children may show a hyperglycemic pattern following seizures as a stress induced response. This does not need correction with insulin.
- Normal maintenance fluid volume can be given to avoid hypoglycaemia and to maintain electrolyte balance. However evidence of raised intracranial pressure or increased antidiuretic hormone secretion should necessitate fluid restriction.
- Assess and maintain electrolyte balance maintaining serum sodium within the normal range (135-145 mmol/L). Avoid hyponatraemia by using Ringer Lactate or Hartmann's solution.
- Aspirate the stomach contents by inserting a gastric tube and perform gastric lavage or give charcoal (1gm per year of child's age) if appropriate for specific drug ingestions
- Regulate temperature, ensuring temperatures above 37.5° C are avoided.
- Treat raised intracranial pressure, if clinically present by:
 - o Supporting ventilation (maintain a P CO₂ of 4.5 – 5.5 kPa)
 - o Maintaining a 20° head up position
 - o Giving 20 % mannitol 250 – 500 mg/kg (1.25 – 2.5 mL/kg) IV over 15 minutes. This may be repeated on a 2 hourly basis as required
 - o Give dexamethasone 500 micrograms/kg twice daily (for oedema surrounding a space occupying lesion).
- Catheterise the bladder as distension may aggravate raised intracranial pressure.
- Frequent reassessment of ABC is mandatory as therapy may cause depression of ventilation or hypotension, especially if benzodiazepines or barbiturates have been used.
- If available a standard EEG can be done to establish cessation of electrical seizure activity.
- Identify and treat the underlying cause of the convulsion
- Following seizure control there are several regimes for continued drug control of the convulsions but they are outside the scope of this text.

Section 15 Paediatric emergencies: convulsions

Pathway of Care Prolonged Fitting in post-neonatal infants and children



Febrile Convulsions

Definition a seizure in a child aged up to 6 years, caused by fever arising from infection or inflammation outside the central nervous system in a child who is otherwise neurologically normal. Simple febrile convulsions are generalized, tonic-clonic seizures. They usually last < 10 minutes (50% last < 3 minutes). A small proportion (5%) last more than 30 minutes. This is a common condition with an estimated prevalence of 2-4% and there is often a family history. Long term effects are rare.

Management

- Temperature control
 - Paracetamol 20mg/kg and / or ibuprofen 4-10mg/kg
 - Tepid sponging
 - fanning
- Identification of the cause of infection – always check the urine

Any child with a prolonged or focal seizure, or who has not recovered within an hour, should be suspected of having serious pathology.

Although most children rapidly make a good recovery, it is important to have considered other causes of fever and/or convulsions before planning to discharge

Causes of fever ± convulsions

- In an endemic area consider malaria
- Urinary tract infection
- Measles in the unimmunised child
- Meningitis or encephalitis
- Hypoglycaemia
- Metabolic abnormality
- Poisoning

Indications for admission after febrile convulsion

- Age < 18 months unless very clear focus of infection
- Signs of meningitis
- Child is drowsy, irritable or systemically unwell
- Recent or current treatment with antibiotics (partially treated meningitis can be missed)
- Complex convulsion, or delayed recovery
- If there are concerns the child may not be able to get back if deteriorates

If a child is being discharged home, make sure the parents

- understand what has happened
- know what treatment their child is on
- understand the importance of keeping the child's temperature down
- will bring the child back if there is a worsening in their condition

Section 16 Severe Malnutrition in the Child

Clinical evaluation

Nutritional status is assessed according to weight for length/height; height for age; and the presence of oedema. Children who are below $-3S.D.$ or who have oedema of both feet, are severely malnourished (see Table)

Mid upper arm circumference (MUAC) is a good way of identifying wasted children as it is relatively constant between 1 and 5 years of age when a MUAC of less than 11.5cm indicates malnutrition.

Features

- Characterised by oedema or wasting (e.g. of the buttocks), anorexia and infection
- Anaemia is frequently present
- Biochemical abnormalities include : low protein, potassium, urea, magnesium and glucose
- Two overlapping clinical pictures are seen, marasmus and kwashiorkor.

Marasmus

- Affects young children
- Due to lack of calories over many weeks
- Extreme thinness with loss of subcutaneous fat and muscle mass
- Prominent bones and joints
- Sunken eyes
- Often hungry and active
- Weight for length < 70% median

Kwashiorkor

- Acute illness, appears over a few days
- Affects children < 4 yrs old
- May be precipitated by acute illness – measles or diarrhoea
- Involves sodium retention and pitting oedema of peripheries
- Causes dermatosis and desquamation
- Dry, brittle hair
- Child is apathetic and feeds poorly
- Associated with persistent anorexia, diarrhoea and vomiting

Mortality from malnutrition can be reduced by correct early treatment. The common causes of early death are

- Hypoglycaemia
- Hypothermia
- Fluid and electrolyte imbalance – particularly hypokalaemia
- Infections and septic shock
- Failure to correct vitamin and micronutrient deficiencies
- Inappropriate IV fluid treatment, including blood transfusion

Harmful aspects of treatment for severe malnutrition

- Too much energy and protein given during first phase of treatment
- Diuretics given to treat oedema causing hypokalaemia
- Anaemia treated with iron early leading to free radical damage and infections
- Vitamin A and measles vaccine not given
- Albumin or amino acids infused

Section 16 Severe malnutrition in the child

- High sodium ORS and intravenous fluids administered
- Routine antibiotics not given
- Failure to monitor food intake
- Lack of overnight feeding
- Hypoglycaemia not monitored and treated
- Hypothermia not monitored and treated
- Inadequate staffing and poor organisation of care

Principles of Treatment

Stabilisation phase(up to 7 days)	Transition over 48 hours	Catch up growth Phase (usually 14-21 days)
Treat or prevent dehydration, hypoglycaemia, hypothermia		
Treat infection	Treat worms	
Correct electrolyte imbalance Correct micro-nutrient deficiencies		
Do not give iron	Do not give iron	Correct iron deficiency
DIET Maintenance intake	Moderate intake	High intake
Stimulate child	Stimulate child	Stimulate child
		Provide physical activities Prepare for discharge

- Treat dehydration cautiously
- Prevent hypoglycaemia and hypothermia
- Treat infection, congestive heart failure and severe anaemia
- Correct electrolyte and micronutrient deficiency
- Provide standard maintenance nutrition within first few days of treatment
- Remember potential for sodium overload and cardiac failure
- Remember signs of coincidental sepsis may be hidden
-

General Treatment

- Keep malnourished patients separate from patients with infections in a warm room without draughts
- wash minimally, with warm water and dry immediately
- avoid IV cannulae / infusions (unless in shock)
 - high risk of heart failure from fluid overload
 - risk of infection
 - give blood transfusion only when anaemia is life-threatening
 - remove IV cannulae immediately after treatment
- use a nasogastric tube for feeding if:
 - anorexia with intake of <80% prescribed
 - severe dehydration with inability to drink oral fluids
 - painful or severe mouth lesions (herpes, cancrum oris, severe oral/oesophageal thrush)
 - recurrent, frequent vomiting

Principles of therapy

Hypoglycaemia (< 2.5 mmol/litre (45mg/dl))

Presume present if unable to test

Treat with 50ml of 10% glucose orally or 50 ml of drinking water with 10 g of sugar via nasogastric tube or 5 ml/kg 10% glucose IV

Prevention by 2 hourly feeds – day and night

Hypothermia

Check with low reading thermometer and keep T > 36.5

Treat with passive re-warming – e.g skin to skin contact with carer

Prevent by keeping child warm, and dry and away from draughts

Avoid prolonged medical examinations and washing

Dehydration

Usually over estimated in malnutrition as reduced skin elasticity and sunken eyes are features of malnutrition

Features suggestive of dehydration as well as malnutrition are

Frequent watery stools

Minimal urine output (no urine output for 12 hours or more)

Thirst

Weak pulse

Treat with oral re-hydration (only give IV if in shock)

Standard ORS has too much sodium and too little potassium – use ReSoMal

Check for fluid overload

Liver enlargement; basal creps; raised JVP: rising pulse ± respiratory rate: oedema

If overloaded, treat with fluid restriction NOT with diuretics

Electrolytes

Malnourished patients have low potassium and magnesium and high total body sodium

Treat with oral replacement

Potassium 3-4 mmol/kg /day

Magnesium 0.5 mmol/kg / day

Infection

Clinical signs may be absent; suspect if hypoglycaemia or hypothermia

Treat all with broad spectrum antibiotics – orally if tolerated. If very unwell give IV

(Amoxicillin 50 mg/Kg 6 hourly plus gentamicin 7.5 mg/Kg once daily OR ceftriaxone 100mg/Kg IM once daily). Note that doses based on actual body weight might be too low – increase by 10% in severe malnutrition

Give measles immunisation if not previously immunised

Treat specific infections –always consider malaria, TB, worms and HIV

Acute severe anaemia

Transfuse at Hb < 4g/dl, or signs of heart failure and Hb 4-6 g/dl

Partial exchange transfusion is better than giving whole blood or packed cells

Withdraw 2.5ml/kg anaemic blood and replace with 5ml/kg whole blood or packed cells

If not exchanging, give 10ml/kg packed cells over 3-4 hours, with frusemide 1mg/kg

Congestive heart failure

Section 16 Severe malnutrition in the child

Serious and common; occurs several days after treatment started; due to cardiomyopathy secondary to malnutrition

Often caused by over hydration, excess sodium, over transfusion, inadequate correction of potassium deficit

Treat with fluid restriction and frusemide 1mg/kg. This is the only situation in which diuretics should be used: **diuretics should never be given to reduce oedema in malnourished children.**

Micronutrients

Single oral dose vitamin A on admission, plus daily supplements of zinc, potassium, magnesium and copper.

Folic acid 5mg stat and 1mg/day

DO NOT GIVE IRON during first 14 days of treatment

If xerophthalmia or measles give 3 doses of vitamin A

Nutrition management

Start feeding as soon as possible

Give small frequent meals of low osmolality, low sodium, low lactose and low protein

Feed throughout the day and night

By careful attention to detail, and maintaining treatment throughout the day and night, severely malnourished children have a better chance of survival.

SECTION 17 Serious Injury in children and in pregnancy

The key principles of managing major trauma are to

Treat the greatest threat to life first
Do no further harm

and

AVOID – hypoxia; hypercapnia, hypovolaemia, hypoglycaemia and hypothermia

The key steps are outlined in the primary assessment, which is intended to enable identification and treatment of life threatening injuries. The secondary assessment identifies potentially life and limb threatening injuries.

Structured Approach to the management of Trauma

- Primary assessment
- Resuscitation and stabilisation
- Secondary assessment
- Emergency treatment
- Definitive care

Primary Assessment

- Airway and cervical spine control
- Breathing
- Circulation and haemorrhage control
- Disability
- Exposure – avoiding hypothermia

Primary Assessment – Airway plus cervical spine control

used for managing any airway, in that you must

LOOK LISTEN FEEL

Airway takes priority over cervical spine protection

Resuscitation:

Do only that which is needed to keep the patient safe

- **Open the airway: Jaw thrust always appropriate but avoid head tilt** if there is evidence of a cervical spine injury unless there is no other way to open the airway as airway opening is always the priority
- **Suction / removal of blood, vomit or a foreign body**
- **Oropharyngeal airway** – avoid nasopharyngeal airway if suspicion of base of skull injury
- **Intubation or surgical airway might be needed**
- **Identify the ‘at risk’ airway**
 - Altered level of consciousness, with failure to protect airway
 - Vomiting with risk of aspiration
 - Facial trauma – including burns

Neck injuries are common in trauma therefore treat as a cervical injury until disproved. Beware of significant incidence of Spinal Cord Injury Without Radiological Abnormalities (SCIWORA) in children

Primary Assessment- Breathing

After management of the airway and securing of the cervical spine, the patient's breathing should be assessed. The same approach is adopted as for the patient suffering a serious illness.

The approach is similar to that

Section 17 Serious injury in children and in pregnant mothers-structured approach

Assessment of breathing

- **Effort** – recession, rate, added noises, accessory muscles, ala flaring
- **Efficacy** – breath sounds, chest expansion; abdominal excursion; SaO₂
- **Adequacy** – heart rate, skin colour, mental status

Unequal breath sounds or poor oxygenation?

- Misplaced or blocked ETT
- Pneumo / haemothorax

In the primary survey it is important to actively look for life threatening injuries, and to examine the back and the front of the chest (whilst fully supporting and protecting the spinal cord)

- GIVE HIGH FLOW OXYGEN TO ALL
- PROVIDE ASSISTED VENTILATION IF NEEDED

Resuscitation:

Look for and treat

- Airway obstruction
- Tension pneumothorax
- Open pneumothorax
- Haemothorax
- Flail chest
- Cardiac tamponade

Breathing problem	Clinical signs	Treatment
Tension pneumothorax	<ul style="list-style-type: none"> • Decreased air entry on side of pneumothorax • Decreased chest movement on side of pneumothorax • Hyper-resonance to percussion on side of pneumothorax • Tracheal deviation away from side of pneumothorax • Hypoxic, shocked patient • Full neck veins 	<p>High flow oxygen</p> <p>Needle thoracocentesis</p> <p>Chest drain insertion</p>
Open Pneumothorax	<ul style="list-style-type: none"> • Penetrating chest wound with signs of pneumothorax • Sucking or blowing chest 	<p>High flow oxygen</p> <p>Chest drain</p> <p>Wound occlusion on 3 sides</p>

Section 17 Serious injury in children and in pregnant mothers-structured approach

	wound	
Massive Haemothorax – blood in pleural space	<ul style="list-style-type: none"> • Decreased chest movement • Decreased air entry • Dullness to percussion • Shock and hypoxia • Collapsed neck veins 	<p>High flow oxygen</p> <p>Venous access and IV volume replacement</p> <p>Chest drain (A haemothorax of 500–1500 ml that stops bleeding after insertion of an intercostal catheter can generally be treated by closed drainage alone A haemothorax of greater than 1500–2000 ml or with continued bleeding of more than 200–300 ml per hour may be an indication for further investigation, such as thoracotomy.)</p>
Flail chest – paradoxical movement of a chest wall segment associated with underlying lung contusion	<ul style="list-style-type: none"> • Rare in children because they have elastic chest wall • Decreased efficiency of breathing 	<p>Oxygen and pain relief</p> <p>May need intubation/ventilation transfer if feasible</p>
Cardiac tamponade – blood in pericardial sac causing a decrease in cardiac output	<ul style="list-style-type: none"> • Shock associated with penetrating or blunt chest trauma • Faint apex beat and/or muffled heart sounds • Distended neck veins 	<p>Oxygen</p> <p>IV access/IV fluids</p> <p>Emergency needle pericardiocentesis– may need to be repeated</p> <p>Consider transfer if feasible</p>

Primary Assessment - Circulation

Circulatory assessment includes identification of actual and potential sources of blood loss. Closed fractures and bleeding into the chest, abdomen or pelvis may make it difficult to detect how much blood has been lost. The ability to estimate the percentage blood loss is helpful in planning resuscitation. Remember that a child's circulating blood volume is only 80ml/kg so is easily compromised. Blood volume in pregnancy is 100ml/Kg or between 5 and 7 litres.

Note: blood pressure may be normal until up to 50% of a patient's circulatory volume has been lost. Management is focused around avoiding hypovolaemia and controlling blood loss. The following steps should be taken:

Resuscitation: Stop obvious bleeding by direct pressure. Don't forget that the patient may have a wound on the back that is bleeding into the bed. Remember log rolling if indicated.

Concealed bleeding severe enough to cause shock can occur from chest, abdomen, pelvis, femur. Forty percent of the circulating blood volume can be lost via an open femoral fracture. Initial treatment should include pressure, splinting and analgesia.

Vascular access is essential in all seriously injured patients.

A minimum of 2 relatively large bore IV cannulae is essential.

Peripheral veins are preferable – the inexperienced should not attempt central venous cannulation.

Do not forget about the intraosseous route in a child if venous access is not possible. A cut down onto the long saphenous vein can also be used.

IV fluid resuscitation

The goal is to restore oxygen delivery to the tissues. As the usual problem is loss of blood, fluid resuscitation must be a priority.

- Adequate vascular access must be obtained. This requires the insertion of at least one, and ideally two, large-bore cannulae (14-16 G). Peripheral cut -down or intraosseous infusion may be necessary.
- Infusion fluids (crystalloids e.g. Ringer Lactate or Hartmann's solution: normal (0.9%) saline can be used if the previous fluids are unavailable, but be aware that especially in larger volumes, normal saline causes a hyperchloraemic acidosis which is detrimental to sick or injured patients) should be warmed to body temperature if possible (e.g. prewarm in bucket of warmed water). Remember hypothermia can lead to abnormal blood clotting.
- Avoid solutions containing glucose.
- Take any specimens you need for laboratory and cross- matching urgently.

Not all cases of hypovolaemia require aggressive fluid therapy. In adults, withholding fluids in penetrating trunk trauma before achieving surgical haemostasis has been associated with improved outcome. The concept is to avoid pushing up the blood pressure, which hinders clot formation and promotes further bleeding. Aggressive fluid replacement can lead to increased fluid requirements, hypothermia, dilution of clotting factors, excessive blood transfusion and its associated immunosuppression.

On the other hand, in severe head injury, cerebral perfusion is critically dependent on maintaining blood pressure. If a patient has both a severe head injury and major trunk bleeding, the apparently conflicting requirements are best managed by maintaining

Section 17 Serious injury in children and in pregnant mothers-structured approach priorities in ABC order and achieving prompt surgical haemostasis. Beyond this strategic conflict, it should be remembered that the normal blood pressure is lower in children, hypovolaemia mimics head injury and blood pressure itself is a poor indicator of organ perfusion.

This has led to a much more cautious fluid regime, until the risk of uncontrolled bleeding has been ruled out.

As outlined above, the concept of “hypotensive resuscitation” is important if the cause of hypovolaemic shock is haemorrhage from penetrating injury. Here, the initial boluses of IV crystalloids required to treat shock should only be given to keep the vital organs (especially brain, heart and kidneys) perfused before emergency surgery and blood transfusion is available. Fresh blood is particularly useful to combat the coagulopathy that occurs in major blood loss if specific coagulation components such as platelets are unavailable.

Giving too much IV fluids can increase the blood pressure too far thus increasing bleeding by disrupting early clot formation. IV crystalloid also dilutes the red cells in the circulation but whether or not this could reduce oxygen carrying capacity requires further research.

Our suggestion is that when giving boluses of crystalloid or blood in shock due to bleeding in major trauma, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs should be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a pregnant woman or child in shock due to haemorrhage. Adequate perfusion of vital organs may best be indicated by the following: a radial pulse which can be palpated and a conscious level of A or V on the AVPU scale (i.e. the woman or child is either awake or will respond by opening his/her eyes when spoken to). During pregnancy, the adequacy of the fetal heart rate may also be helpful.

In children under 2-3 years of age, the radial pulse may be difficult to feel and the presence of a palpable brachial pulse may be the best available indicator at present.

Therefore to maintain a palpable radial pulse in pregnancy, start with IV boluses of 250 - 500 mL of crystalloid or ideally blood and reassess after each.

In children to maintain a radial or brachial pulse give 10mL/kg IV boluses of crystalloid or, ideally, blood and reassess after each.

In the absence of further evidence, it is recommended that in children, start with 10 mL/kg boluses (infusions given as rapidly as possible) of Ringer-Lactate or Hartmann's or plasma expander with frequent re-assessment, rather than the full 20 mL/kg recommended in other life-threatening situations such as meningococcal sepsis or severe dehydration.

Fluid resuscitation in pregnancy starts with a 250-500 ml bolus of Ringer-Lactate or Hartmann's or plasma expander.

After repeating boluses twice (that is 10 mL/kg x 2 in a child, or 500 mL x 2 in pregnancy), the transfusion of packed red cells should be considered. The most important aspect of fluid resuscitation is the patient's response to the fluid challenge.

Improvement is indicated by:

- decrease in heart rate
- increased systolic blood pressure
- increased skin temperature
- quicker capillary refill
- improving mental state

Section 17 Serious injury in children and in pregnant mothers-structured approach

Failure to improve should prompt an urgent search for chest, abdominal, or pelvic haemorrhage, with the immediate involvement of an experienced surgeon. Similar volumes may be repeated if there is continuing evidence of haemorrhagic shock, after re-evaluating the state of the circulation.

It is useful to delegate the initial fluid bolus to a member of the trauma team (if a team is available), who attaches the warmed fluid bag to the intravenous cannula via a three-way tap to which is attached a 20 or 50 mL syringe to give the boluses.

Early surgical involvement is essential.

Blood transfusion

There may be considerable difficulty in getting blood. Remember possible incompatibility, hepatitis B and HIV risks, even amongst patient's own family.

Blood transfusion must be considered when the patient has persistent haemodynamic instability despite fluid (colloid/crystalloid) infusion. If the type-specific or cross-matched blood is not available, type O negative packed red blood cells should be used. Transfusion should, however, be seriously considered if the haemoglobin level is less than 7 g/dL and if the patient is still bleeding. Blood transfusion is most important and requires blood to be taken for urgent cross match.

As described above, early surgical involvement is essential.

Vascular access is essential in all seriously injured patients. A minimum of two relatively large bore IV cannulae is essential.

Infusion IV line flow rates

Color Code (mL/min)	Gauge	crystalloid flow rates
Brown	14	240
Gray	16	172
Yellow	17	130
Green	18	76
Pink	20	54
Blue	22	25
Lime	24	14

Peripheral veins are preferable – the inexperienced should not attempt central venous cannulation. The external jugular vein can be accessed even in shock but the cannula can become easily displaced and must be very carefully taped in place. A cut-down onto the long saphenous vein can also be used.

Management of circulation

- Peripheral or IO access
- Direct pressure on bleeding sites
- External jugular or femoral venous access
- Saphenous or cephalic cut down
- Fluid resuscitation if any evidence of shock
- Monitor response and only continue with fluids if needed
- **Do not give excess fluids – especially to patients with head or chest injuries, or malnutrition**
- Consider need for surgical intervention

If possible take blood for

- Cross matching
- Hb and full blood count
- Glucose
- Electrolytes

The most important aspect of fluid resuscitation is the response to a fluid challenge.

Improvement is indicated by

- Decreased heart rate
- Increased skin temp
- Faster capillary refill
- Improved mental state
- Increased systolic BP
- Improved urinary output

If the patient fails to improve, look for chest, abdominal or pelvic blood loss and consider surgical intervention

Fluid Resuscitation

Crystalloid / colloid 10 ml /Kg in child or 250 – 500 ml in pregnant woman or girl

Monitor response
If no change or worse
Repeat above bolus



Monitor response: no change/ worse



Urgent surgery may be needed

Warnings

Cardio-respiratory arrest despite secure airway and adequate oxygenation:

- Tension pneumothorax **needs** emergency thoracocentesis and insertion of intercostal drain(s)
- Exsanguination **needs** large fluid boluses and blood transfusion
- Pericardial tamponade **needs** pericardiocentesis

Primary Assessment - Disability

Head Injury is the major cause of death in trauma

Rapid assessment of the CNS includes

- Applying AVPU score
 - Aim to intubate with a score of 'P' or 'U' as the airway is unprotected
 - Remember to check for a pain response above the level of the clavicle as a patient with a spinal injury may not be able to respond
- Look for signs indicative of injury e. g., bruises, lacerations or haematoma in the head and neck area
- Examine the pupils for size, equality and reaction to light and look for other lateralizing signs like weakness of a part of body and localised seizures etc

Resuscitation: the brain is best cared for by close attention to managing A B and C and correcting any hypoglycaemia. If raised ICP, intubate, ventilate, (to maintain oxygenation and aim for PCO₂ of about 4kP) maintain systolic BP, give mannitol 0.5mg/kg, nurse the patient 30° head up and contact a neurosurgeon (if available).

- Low blood glucose is common in child trauma victims and can cause brain injury. Always check the blood glucose and if not possible - treat immediately any baby or small child with 5ml/kg of 10% glucose IV.

Primary Assessment – exposure – avoid hypothermia

Undress patient fully and examine front and back, looking for evidence of injury. Remember to use a log roll when examining the back. Always keep warm (especially infants and small children). If hypothermia is suspected, check rectal temperature with low reading thermometer.

The injured patient should have

- Clear airway and 100% oxygen for breathing
- Cervical spine immobilisation
- Adequate respiration, achieved by manual or mechanical ventilation and chest decompression when indicated
- Venous access and an initial fluid challenge, if indicated on circulatory assessment
- Blood sent for typing and cross matching
- Identification of the need for life saving surgery and preparation underway
- Identification of any serious head injury and attention paid to A B and C

Life threatening injuries identified and treated

Injury	Treatment
Airway obstruction	Jaw thrust, oropharyngeal airway, intubation or surgical airway
Tension pneumothorax	Needle thoracocentesis and chest drain
Open pneumothorax	3 sided dressing, then chest drain
Massive haemothorax	IV access, chest drain and blood transfusion
Flail chest	Intubation if needed
Cardiac tamponade	Pericardiocentesis Spinal needle ideal UBL (Upwards, Backwards, Left)

Section 17 Serious injury in children and in pregnant mothers-structured approach
At the same time, or shortly after the primary assessment, resuscitation and stabilisation, various adjuncts help with patient management.

Primary Assessment – Adjuncts

- Monitoring ECG, SaO₂ and BP
- Urinary and gastric catheters
- X-rays of chest, pelvis (± cervical spine)
- Ultrasound of abdomen if available
- Adequate pain control (see below)
- Base line blood tests (especially Hb, cross match, biochemistry and clotting)

History

- Events before and after incident
- First aid given at scene
- Past medical history
- Medications and allergies
- Immunisation status
- Last food and drink

Analgesia (see section on pain control)

- **There is never any reason to withhold analgesia from a patient in pain**
- **Morphine – 100micrograms/kg IV or 5-10mg in the mother is the drug of choice in major trauma**
- **If conscious level falls, the effect can be reversed with naloxone**

Secondary Assessment

On completion of the primary assessment and any necessary resuscitation – including emergency surgery – a secondary assessment must be completed.

The aim is to identify all injuries in a systematic manner

If, at any time, the patient's condition worsens, return to the Primary A

Summary of secondary assessment (* CT scan might be indicated if available)	
Head * Perform a full neurological examination	Look for lacerations, bleeding, bruising Palpate for fractures or deformity Look for signs of # base of skull – periorbital bruising; blood behind the eardrum; CSF leak or bleeding from the nose or ears Consider need for Skull X-ray
Face	Check orbits; maxilla, mouth and mandible Check the teeth
Neck	Remember that bradycardia and hypotension could be the signs of a spinal injury **Treat any spinal injury with 0.5mg/kg of dexamethasone Careful examination front and back. C. spine X-ray if available, but be aware of Spinal Cord Injury Without Radiological Abnormality (SCIWORA) Check for bony deformity or tenderness and any neurological deficit Feel for surgical emphysema and look for penetrating wounds
Chest*	Reassess as in primary survey. Look for penetrating injuries and think about cardiac tamponade. Make sure the posterior chest is properly examined for flail segments Review CXR looking for evidence of aortic damage, lung contusion and pneumothorax. Do ECG if available
Abdomen	Look for signs of bruising and penetrating trauma Palpate and percuss gently. Listen for bowel sounds Check renal angles and examine urine for blood Ultrasound is useful if available
Pelvis	Gentle palpation. If identify a fracture, immobilise the pelvis to contain bleeding. Check perineum and urethral meatus for signs of bleeding Palpate the bladder Review X-ray
Thoraco-lumbar spine	Log roll for examination Palpate for tenderness and deformity Perform careful assessment of motor and sensory function in limbs
Limbs / extremities	Examine musculoskeletal system, peripheral nerves, distal circulation Assess for fractures and soft tissue injuries; immobilisation is a good method of pain relief Always consider the risk of compartment syndrome – especially in the lower leg and with injuries to the forearm. Bleeding is best controlled with direct pressure, rather than with a tourniquet. Involve orthopaedic surgeons early.

Emergency Radiology

The key X-rays in evaluating major trauma in the primary assessment / resuscitation phase, are the AP chest X-ray, the pelvic X-ray and lateral cervical spine radiograph. Other useful X-rays include the cervical spine, skull and limbs, as indicated during the secondary assessment.

Chest X-ray (CXR)

There are many schemes for examining the CXR in trauma. It is important to remember that, unlike with medical conditions, trauma is not usually confined to anatomically discrete areas. This means that great care must be taken to ensure multiple pathology is not missed. The child's chest wall is very elastic, so the energy from an impact may be transmitted to the heart and lungs, without causing rib fractures. If rib fractures are seen, this indicates a high energy impact.

Note that in a supine film, air/fluid levels will not be detected and a haemothorax may be seen as a generalised 'greyness' of the involved lung

System for examining the CXR in trauma		
A	Adequacy	Correct patient. Apices, bases and edges of lung visible on both sides
A	Airways	Trachea central. Examine lungs for increased or decreased density, and lung markings to edge of pleura;
B	Bones	Check all ribs for fractures – look for flail segment. Check spine alignment, clavicles and shoulder
C	Cardiac outline & mediastinum	Look for pneumomediastinum; increased heart size (is wider on AP film); note the thymus in children up to 6-8
D	Diaphragm and pleura	Look for air above and below diaphragm (not seen if supine film). Note any fluid or air in the pleural space
E	Everything else	Tubes – check position of ETT, chest drain, NGT, central line. Foreign bodies on chest wall or in chest Peripheral soft tissues for subcutaneous air

Pelvic X-rays

If there is disruption to the pelvis, it is very likely that the nerves and blood vessels running close by will also be damaged. This can lead to life threatening blood loss.

Remember that there are three 'rings' to inspect – the pelvic brim, and both obturator foramina. If there is a break at one point, look very carefully for another disruption – it is almost impossible to break a ring in one place only

System for examining Pelvic X—ray in Trauma		
A	Adequacy	Correct patient Check L5, sacrum, iliac crest and proximal femurs present
A	Alignment	Symphysis pubis midline, normal width Check 3 rings – pelvic brim and both obturator foramina
B	Bones	Look for damage to the outer edge of the pelvis; the trabecular pattern of the bones Inspect the femoral head and neck, and the lumbar vertebrae for fractures
C	Cartilage and joints	Inspect the sacro-iliac joints and compare the two sides
S	Soft tissues	Look for foreign bodies and the position of obturator internus – normally seen both sides of the pelvis, but obliterated or displaced with haemorrhage

Cervical Spine X-ray in Trauma

The lateral cervical spine X-ray will only identify about 80% of fractures, and is no substitute for a good clinical examination. It may not always be available, and cannot be used as the only reason for removing neck immobilisation.

Up to 60% of spinal cord injuries occur in children without any abnormality being seen on the X-ray

SCIWORA = Spinal Cord Injury WithOut Radiological Abnormality

If in doubt about an x-ray, consider it to be abnormal and continue with immobilisation

System for examining Cervical Spine X-ray in Trauma		
A	Adequacy	Correct patient. Check X-ray includes C1 – top of T1, the base of skull, top of shoulders, trachea and spinous processes
A	Alignment	Look for three smooth lines –anterior and posterior to the bodies of the vertebrae; and the posterior border of the vertebral canal. Look carefully for mal-alignment – but be aware that a degree of subluxation may be normal
B	Bones	Check each bone carefully looking for breaks in the cortex, or loss of height. Inspect the base of the odontoid peg
C	Cartilage and joints	Compare the joints of each vertebra with the ones above and below looking for similarity of disc space, facet joints and inter-spinous distance. Note the gap between C1 and C2 which should be < 5mm
S	Soft tissue	Look for swelling in the pre-vertebral space – anything > 1/3 width of C2 at that level, or > width of the vertebral body below C4 suggests presence of a haematoma and ligament damage

Section 17 Serious injury in children and in pregnant mothers-structured approach
Skull X-ray in Trauma

The most useful investigation in trauma, is a CT scan. If this is not available, a good quality skull X-ray and period of careful neurological observations, is a good alternative. The indications for skull X-ray are below

Indications for Skull X-ray (in absence of CT scan)

- P on AVPU score
- Loss of consciousness or period of amnesia
- Suspected base of skull fracture
- Suspected penetrating injury or depressed fracture
- Significant scalp bruising or swelling
- Significant mechanism of injury
- Persistent headache, vomiting or fitting
- All non-mobile infants with head injury
- Suspected non-accidental injury
- Difficult to assess patient – e.g. under influence drugs or alcohol

Analgesia

There is no excuse for withholding pain relief from any patient who is in pain. If the patient is aware enough to respond to pain, then they can experience pain and need to be helped. Pain increases fear and distress, makes the patient less able to co-operate and raises intracranial pressure.

Pain relief takes several different forms

- Reassurance
- Splinting of fractures
- Covering wounds – especially burns
- Drugs
- There is no place for oral or IM medication in a major trauma situation
- The drug of choice is IV morphine 100 micrograms/kg titrated to response
- Entonox (50/50 O₂/N₂O) is useful, especially for limb injuries whilst splints are being applied. Do not use if head, chest or abdominal trauma

A head injury is NOT a contra-indication for giving morphine

MAJOR TRAUMA IN PREGNANCY

Physiological changes of pregnancy which affect the management of trauma

Increased basal heart rate to 85-90 beats per minute

Fall in blood pressure 5 - 15 mm Hg

Blood volume increased by 40% to 100ml/Kg

Vena-caval compression as uterus increases in size

Upward displacement of diaphragm as uterus increases in size

Action plan

1. Call for the most senior help available
2. Take history and note mechanism of injury. Ask about direct impact, a deceleration injury e.g. a car accident or fall, penetrating injury, stab wound,

Section 17 Serious injury in pregnancy

gunshot etc. Ask about symptoms and signs. Ask about any treatment already given.

3. Consider any pre-injury condition which may affect management.
4. Perform primary assessment and resuscitation

Structured approach to the pregnant patient

- Primary assessment - find threat to life
- Resuscitation - deal with these threats to the life of the pregnant woman or girl
- Assess fetal well-being and viability - deal with threats to life of the fetus
- Secondary assessment - full examination
- Definitive care - specific management

Primary Assessment

Airway and breathing

- Airway plus cervical spine control
- Supplemental oxygen via a tight fitting facemask and reservoir bag at a flow of 12 - 15 litres per minute
- Protect airway if the patient is unconscious. Early endotracheal intubation using a cuffed tube to protect the airway and control ventilation to ensure normal oxygen and carbon dioxide levels can minimise brain injury.

Circulation

- Circulation may be compromised by a pregnant uterus and aorto-caval compression: prevent by a lateral tilt or manual displacement of the uterus with spine immobilisation.
- Aggressive volume replacement.

Recognise signs of hypovolaemia, which are delayed in pregnancy as the pregnant woman or girl has a higher circulating volume (see shock). Hypovolaemia may compromise the fetus before the pregnant woman or girl vital signs become abnormal.

Disability

Early assessment by AVPU:

- Alert
- Responding to Voice
- Responding to Pain
- Unresponsive

Secondary assessment

After completion of the primary assessment and performing any measures necessary for immediate resuscitation, a full examination should be performed to identify any potentially lethal or non lethal injuries sustained. If the woman has experienced major trauma, x-rays of the chest, pelvis and cervical spine should be taken. A thorough assessment of fetal well being should be performed. Previously undetected lethal chest injuries in the pregnant woman or girl may be identified.

In cases of major trauma remember there are four areas for concealed blood loss: chest; abdomen; pelvis; long bone fractures.

To avoid supine hypotension in the pregnant patient, the right hip should be elevated with a towel, pillow or wedge and the uterus displaced manually (left lateral tilt).

Commence intensive monitoring of:

- Heart rate, capillary refill time, respiratory rate
- Blood pressure

Section 17 Serious injury in pregnancy

- ECG
- SaO₂ and fetal heart
- Head to toe examination including log roll to examine back, maintaining spine protection if appropriate.

Abdominal examination

Consider:

- Signs of blunt trauma which may cause placental separation up to 48 hours after trauma, fetal distress or death
- Abdominal haemorrhage from injury to intra-abdominal organs
- Uterine rupture

Assess for:

- fetal distress
- vaginal examination to diagnose cause of bleeding or rupture of the membranes (be very careful if there is a possibility of placenta praevia).

Further management

- Correct hypoxia by high flow oxygen and intubation if available
- Correct maternal hypovolaemia with warmed IV fluids/blood
- Assess fetal wellbeing. Use ultrasound to detect fetal heart rate and to identify any retro-placental or intra-abdominal bleeding.
- Detect any abnormal position of the fetus suggesting rupture of the uterus
- Make an early decision to perform Caesarean section for fetal or maternal reasons

Indications for Caesarean section (if safely available):

Fetal distress with a viable fetus

Placental abruption (separation)

Uterine rupture

An unstable pelvic or lumbo-sacral fracture with the patient in labour

Inadequate exposure during laparotomy for other abdominal trauma

Cardiac arrest

Peri-mortem Caesarean section

Undertake this when cardio-pulmonary resuscitation (CPR) has been started. Left sided tilt and CPR are continued throughout as there are reported cases of late maternal survival following delivery of the baby.

Post mortem Caesarean section

There is a poor success rate for fetal survival but it has been reported.

Specific types of trauma

Blunt trauma

The three commonest causes are motor vehicle accident, falls and domestic violence.

A pregnant uterus is a resilient organ and uterine rupture is rare. There is a high chance of haemorrhage from the fetus into the mother which can be detected by Kleihauer testing if available. There is a significant danger of placental separation with blunt trauma to the abdominal wall. Detection of intra abdominal haemorrhage may be difficult so early laparotomy is recommended. Remember the pregnant woman or girl may lose a third of her blood volume before the vital signs become abnormal.

Section 17 Serious injury in pregnancy

Penetrating Abdominal Wounds

Knife and gunshot wounds are the most common. Penetrating injuries can cause uterine injury at any stage of pregnancy. The uterus, fetus and amniotic fluid reduce injury to the pregnant woman or girl by absorbing energy and displacing bowel upwards and to the side. Penetrating injuries above the uterus tend to cause extensive gastrointestinal and vascular damage. Early exploratory laparotomy should be performed to assess and treat injury. Penetrating wounds carry a high risk of major bowel or organ damage so exploratory laparotomy is therefore virtually mandatory.

Thoracic trauma

Chest trauma in pregnancy provides a combination of injury to major thoracic structures and the disadvantage of a large gravid uterus that can easily impair venous return and compromise respiration. Most injuries can be identified by careful assessment and managed with simple measures including the avoidance of aorta caval compression.

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Pathway of Care: Trauma in Pregnancy

Ensure anti-tetanus measures

X rays as needed

On discharge to report abdominal pain, decreased fetal movements,
vaginal bleeding or fluid leakage

**Primary Assessment
and Emergency
Care**

- Airway:** increased risk aspiration – early gastric tube
- Breathing:** chest drains if needed place at higher level 3-4 ics
- Circulation:** left lateral tilt
Abnormalities in pulse rate, BP, capillary refill
are late because of hypervolaemia of pregnancy
Significant hypovolaemia compromises fetus –
therefore aggressive treatment with 0.9% saline
and then blood (if haemorrhage), **avoid
hypotension**
- Disability:** convulsions may be due to eclampsia as well as
head injury

Secondary Assessment

Additionally look for

- placental separation after blunt trauma to abdomen (uterine tenderness, vaginal bleeding, shock)
- premature rupture of membranes
- ruptured uterus (eg seat belt injury) – shock, dead fetus, easy palpation of fetal parts, abdominal fluid

Assess for fetal distress

Assess uterus for contractions, abruption placenta or rupture

Cervix and vagina examined by speculum for amniotic fluid and source of any vaginal bleeding

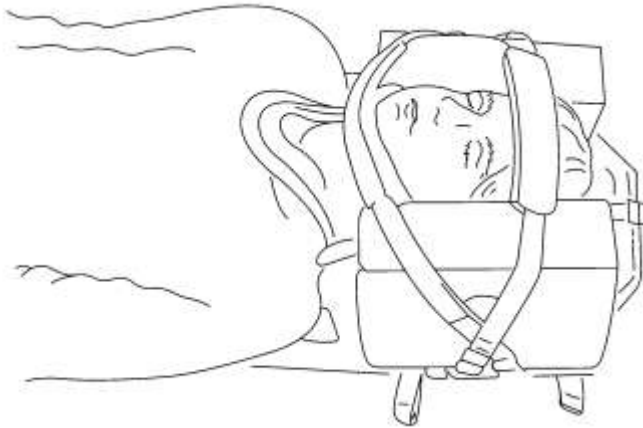
Consider bowel injury (compressed by uterus and therefore more vulnerable to blunt trauma or penetrating injuries)

Practical Procedures related to trauma

Cervical spine immobilization

All patients with major trauma should have full spinal stabilisation and be treated as if they have a cervical spine injury until proven otherwise. Immobilisation can be achieved

- either by holding the head still and in line (manual in-line immobilisation)
- or by applying
 - a semi-rigid collar, which has been correctly fitted
 - sandbags on either side of the head,
 - and tape across the forehead and the chin piece of the collar to prevent the heads being lifted off the bed.



Head-blocks and straps

Exceptions Two groups of patients may prove to be difficult

- the frightened, uncooperative child (most common)
- the hypoxic, combative patient

In both these cases over enthusiastic efforts to immobilise the neck may increase the risk of spinal injury as the patient fights to escape. The area of greatest mobility in the cervical spine is the C7/T1 junction and this is at increased risk in the combative patient.

It is best to try and apply just a collar and address the patient's other clinical needs.

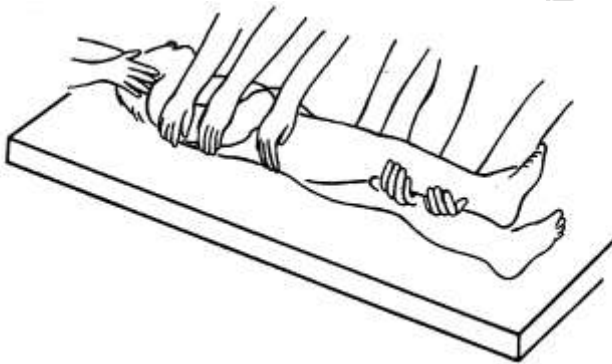
Log roll

When examining the back of the patient, it is important to minimise the risk associated with unrecognised spinal injury. It is essential to examine the back of the patient at the end of the primary assessment (or even during it if there is suspicion of serious injury to the back of the chest or abdomen)

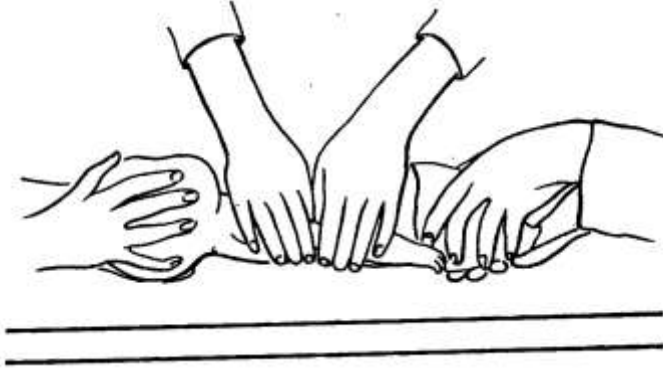
The aim of the log roll is to maintain the orientation of the spine during turning of the patient. It requires four people for a pregnant woman or girl or child and three for an infant. In addition one person is required for the examination of injuries.

Section 17 Practical procedures major trauma-log roll

	Position of staff for log roll	
Staff number	Infant or small child	Larger child or pregnant woman or girl
1	Examination of back	Examination of back
2	Stabilisation of head and neck – in charge of the procedure	Stabilisation of head and neck – in charge of the procedure
3	Chest	Chest
4	Pelvis and legs	Pelvis
5		Legs



Logrolling a child



Logrolling an infant

Pericardiocentesis

Indication – in the trauma situation this is performed when cardiac tamponade is suspected. This is usually, but not always caused by a penetrating injury between the nipple line, or the shoulder blades. The clinical findings are shock, muffled heart sounds (although this is a difficult sign to elicit with confidence) and distended neck veins. It is important to differentiate between this and tension pneumothorax, in which the trachea is deviated and air entry reduced on the affected side.

Ideally this procedure should be carried out under ECG control, but if that is not available, extra care must be taken.

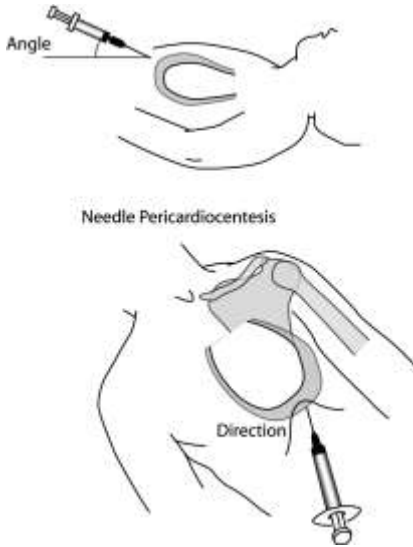
Procedure

- Lie child on the back and attach ECG
- Prepare yourself and patient; this is a sterile procedure
- If conscious, infiltrate local anaesthetic at the costal margin just below the xiphisternum
- Attach cannula to syringe and insert cannula just below and left of the xiphisternum
- Angle at 45° and advance towards the tip of the scapula
- Aspirate continuously whilst advancing and watch the ECG
- Blood will flow into the syringe when the pericardial sac is entered
- Watch the ECG for arrhythmias, ectopic beats or injury pattern – all signs that the myocardium has been touched
- If bright red blood flows in large amounts, the heart has been entered, and the cannula should be withdrawn
- If successful, cardiac function should improve immediately
- Withdraw needle and leave cannula in place with a 3-way tap for further use

Section 17 Practical procedures major trauma-pericardiocentesis

Pericardiocentesis is a temporary procedure. If repeat aspiration is needed, it is likely that a pericardiotomy will be needed. Discuss the case with a cardiothoracic surgeon if available.

For pregnant woman or girl need longer needle eg. Lumbar puncture needle



Section 18 Burns, electrical injuries, envenomation and poisoning

Follow a structured approach

Primary assessment

Remember other injuries may exist. Follow a structured approach

Emergency treatment

Follow a structured approach

Secondary assessment

Other injuries may occur from a blast, falling objects, or while trying to escape. Follow a structured approach

The commonest cause of death within the first hour after burns is smoke inhalation. Thus attention to the airway and breathing is of prime importance.

- Primary assessment and resuscitation ABC. If signs of developing or actual airway obstruction, call for anaesthetist, open the airway and consider early intubation before swelling and total respiratory obstruction occurs. Observe closely for shock.
- Take a very brief history: could there be other injuries or medical conditions?
- Make a rapid assessment of the burn area, care with clothing removal and cooling.
- If clearly more than 10%, establish an intravenous cannula and give intravenous analgesia (morphine 100 micrograms/kg as a loading dose).
- Commence either Ringer Lactate or Hartmann's solution in the following amounts:
 - Burn (%) x Weight (kg) x 4 per day
- Fluid is given over the first 24 hours, backdated to the time of the burn. Half of the fluid should be given (in hourly divided doses) during the first 8 hours, and the second half in the next 16 hours, again in hourly doses. This is in addition to maintenance fluids which can be given later and orally if the child is able to take these (see below). Any fluid boluses given IV to treat shock should be included in the additional fluid for the burn and subtracted from that calculated as above.

Note: normal (0.9%) saline can be used if the Ringer Lactate or Hartmann's solution are unavailable, but be aware that especially in larger volumes, normal saline causes a hyperchloraemic acidosis which is detrimental to sick or injured patients.
- Even if less than 10%, consider intravenous opiate analgesia if the child is clearly distressed.
- Do not give oral fluids immediately.
- Make an accurate assessment of the area of the burn and draw its position on a chart
- Estimate the depth of the burn.
- Establish, and if necessary update, the anti-tetanus status of the child.
- Consider and decide whether an escharotomy is necessary.
- Dress the burned areas, or treat any area which is going to be kept exposed.
- Consider and decide whether the child needs admission (with parent).
- Commence oral fluids if the child can drink. If the child cannot drink, add the maintenance fluids to those given for the burn as calculated above. In burns >8% divide the calculated daily maintenance requirement by 24 and give it on an hourly basis either orally or IV.

Section 18 Severe burns in the child

- Decide if the child requires urinary catheterisation (>30% burns, or with complications).

Surface area

- estimate using burns charts
- or with the patient's palm and adducted fingers (1% body surface area)
- do not use rule of nines <14 years old, but acceptable for pregnant women or girls

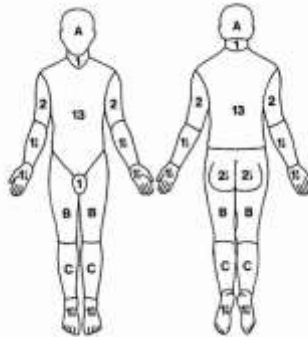
Depth

- superficial - injury only to the epidermis; skin is red with no blister formation
- partial thickness - some damage to the dermis; blistering is usually seen and the skin is pink or mottled
- full thickness - damage to epidermis, dermis and below; the skin looks white or charred, and is painless and leathery to touch.

Special areas

- face and mouth - risk of inhalational injury
- hand - can cause severe functional loss if scarring occurs
- perineal burns - prone to infection and are difficult to manage

Area indicated	Surface area (%) at				
	0	1 year	5 years	10 years	15 years
A	9.5	8.5	6.5	5.5	4.5
B	2.75	3.25	4.0	4.5	4.5
C	2.5	2.5	2.75	3.0	3.25



Section 18 Severe burns in the child

Pathway of Care: burns in a child

Primary Assessment:

Airway – look for inhalation injury – deposits round mouth
- carbon in sputum
- burns to face

Breathing – look for lung injury
circumferential burns to chest

Circulation – shock is late in burns
Disability – AVPU, pupils, posture
Carbon monoxide poisoning?

Emergency treatment:
Airway - protect
Breathing - high flow oxygen
Circulation - IV access, bloods for FBC, X match
Disability - if PU on AVPU support airway and breathing

Secondary assessment: Exclude other injuries
Assess burn - surface area
depth – superficial, partial thickness, full thickness?
Special areas involved? – mouth, hands, perineum

Treatment:
Analgesia – oral codeine, entonox, IV morphine, ketamine
Consider ranitidine for stress ulceration (refer to paediatric formulary for dosage at different ages)
100% O₂ if CO poisoning

IV Fluid therapy - burns >10%

Fluid (crystalloids) additional to maintenance ml/day = % burn x wt (Kg) x 4

Give half of additional fluid in first 8 hours – colloids may be better but are not calculated according to this formula

Keep urine output >1ml/kg/hr

Wound care - cover burns with sterile dressings
leave blisters
prevent contractures

High protein diet + multivitamins

Monitor Hb

Mobilise

Splint joints in position of function

Specific treatment

Analgesia

- IV morphine 100 micrograms/kg early in burn if severe pain is present: later use WHO ladder
- Ketamine 5 to 10mg/Kg in a child can be given orally, PR or IM for dressing changes. If given IV, use lower dose of 500 micrograms to 1mg/Kg. **Person administering this drug must be able to maintain the airway and breathing.** In children give atropine 20 micrograms/Kg IM before the ketamine.
- Consider ranitidine oral or IV (refer to paediatric formulary for dosage) twice daily to reduce stress ulceration

Inhalation of toxic fumes

- toxic gases include carbon monoxide and hydrogen cyanide
- give 100% oxygen

Fluid therapy

- with burns of >10% give IV fluids **additional to maintenance.**
- calculate as fluid (ml of crystalloid) / day = percentage burn (%) x weight (kg) x 4
- give half this in the first 8 hours (calculate from the actual time of burn) after the burn - (Ringer-Lactate or Hartmann's)

Assessment of the size and extent of the burn is difficult. This formula is only a rough guide and it is essential to reassess the fluid state of the patient regularly.

- keep urine output at >1ml/kg/hour
- consider bladder catheterisation if shocked

Wound care

Started early, this will reduce infection and provide analgesia

- Cover burns with sterile towels / cling film (not circumferentially)
- Leave blisters intact
- Avoid unnecessary examination
- Prevent contractures: escharotomies if burn constricts limb blood supply.

The pregnant woman or girl with burns

Any burn affecting more than 20% total body surface area (TBSA) is a serious risk to the pregnant woman or girl and fetus. In a pregnant woman or girl with a burn > 70-80% of the TBSA mortality is 50-90%. If the burn affects < 30% TBSA the prognosis is good for both fetus and pregnant woman or girl and depends on the management of complications such as hypoxia, hypotension and sepsis. If the pregnancy has reached more than 36 weeks, delivery maybe advisable before complications set in.

Immediate first aid involves extinguishing the flames by wrapping the patient in a blanket or equivalent. Small burns can be cooled with clean cold water but if the burns are extensive, cold water may cause hypothermia.

Fluid loss is greatest in the first 12 hours, causing disturbances in fluid and electrolyte composition.

Primary Assessment

Airway and breathing

Airway burns may cause immediate **or delayed** airway compromise so **consider early intubation** as severe swelling of the airway can lead to obstruction. Chemical damage may occur from highly irritant gases, which can lead to progressive respiratory failure. Many plastics and modern materials give off cyanide, which may be absorbed into the blood stream. Many plastics and modern materials give off cyanide, which may be absorbed into the blood stream. Carbon monoxide is the most common poison produced in fires.

Circulation

Assess the amount of body surface area burned

The rule of nines is used to assess the body surface area burned:

Head and neck 9%

Each upper limb 9%

Front of trunk 18% (the pregnant abdomen would represent a larger proportion of the total body surface area)

Back of trunk 18%

Each lower limb 18%

Perineum 1%

The area of the patient's palm represents about 1% of the body surface area

Assess the depth of the burn

In partial thickness burns sensation to pinprick and pain, sweat glands and hair follicles are preserved.

In full thickness burns the area is insensitive to pain and may appear dirty or white (the eschar).

A simple test to distinguish between partial and full thickness burns is to pull a hair out: if it comes out easily the burn is full thickness

Assess the circulatory status.

•Secure IV access and replace fluids with warmed Ringer-Lactate or Hartmann's each containing 5 or 10% glucose (see appendix). A pregnant woman or girl requires 2 to 4mls per kg per % of body surface area burnt to be given over the first 24 hours in addition to baseline maintenance fluids. Half of this volume is given in the first 8 hours, half in the next 16hours

•Monitor urinary output (should be > 30 ml per hour)

Section 18 Envenomation

- Assess the need to deliver the fetus. Fetal survival is poor in burns affecting > 50% TBSA. In view of the high perinatal mortality in pregnant women or girls with extensive burns, those who are extensively burned and more than 32 weeks gestation should be delivered soon after admission. Abortion is common in patients with burns > 33% TBSA, especially during the second trimester. Fetal loss during the third trimester can be expected with extensive burns unless delivery occurs within 5 days. If the pregnancy has reached more than 36 weeks, delivery may be advisable before complications set in.

- Consider the need for escharotomy, as burnt tissue may constrict the blood supply to the limbs.

The pregnant woman or girl or child with Electrical injuries

Primary assessment and resuscitation

Call for help and **disconnect the electricity in a safe manner**

Be aware that high voltage sources can discharge through several centimetres of air.

Airway

The upper airway should be opened and secured especially if this is compromised by facial or other injuries. The cervical spine should be immobilised if there is a strong possibility of an unstable fracture.

Breathing

If the patient is not breathing give rescue breaths using a mouth to mouth technique if no equipment is available (e.g. in the home) and, if available, a bag and mask with high flow oxygen through an attached reservoir. If breathing but cyanosed or low oxygen saturation is present give inspired oxygen to keep SaO₂ if pulse oximeter is available between 94 and 98%.

Circulation

If the patient appears lifeless despite the rescue breaths, commence chest compressions and continue CPR as described in chapter 1.12 until help arrives. In the resuscitated or non-arrested patient brought to hospital, after ABC assessment and management, the entry and exit point of the current should be sought in order to determine a picture of the sort of possible internal injuries that could have occurred. Children with significant internal injuries have a greater fluid requirement than one would suspect on the basis of the area of the external electric burn.

Secondary assessment and emergency treatment

Other injuries should be treated in an appropriate and structured manner.

Associated injuries are common in electrocution. Almost all possible injuries can occur as a result of falls or being thrown from the source. Burns are particularly common and are caused either by the current itself or by burning clothing. Tetanic contraction of muscles can cause fractures, subluxations or muscle tearing.

Other problems

Burns cause oedema and fluid loss. Myoglobinuria occurs after significant muscle damage and acute renal failure is a possibility. In this case, it is important to maintain a urine production of more than 2 mL/kg/hour in a child or 60 mL/kg/hour in pregnancy with the judicious use of diuretics such as mannitol and appropriate fluid loading. Alkalinisation of the urine with sodium bicarbonate (1 mmol/kg in a child (1 mL/kg of 8.4% or 2 mL/kg of 4.2% solution) or 50 mmol in pregnancy increases the excretion of myoglobin.

Section 18 Envenomation

Arrhythmias can occur up to a considerable time after the electrocution, and continuous ECG monitoring is helpful, if available.

Drowning in the pregnant woman or girl or child

Emergency treatment

- assess ABC and cervical spine
- assume neck injury in all cases, especially after diving
- ensure adequate oxygenation
- remove all wet clothes
- external re-warming if core temperature > 32 degrees C (radiant heaters, warmed dry blankets)
- core re-warming if core temperature < 32 degree C (warmed IV fluid (39 degree C) or gastric/lavage with warmed crystalloid at 42 degree C and heated humidified oxygen at 42 degree C)
- assume the stomach is full of water
 - aim for early nasogastric drainage and intubation (if possible)
- anticipate and treat hypothermia (measure with low reading thermometer in rectum)
- beware of shock after warming from vasodilatation (prevent core temperature exceeding 37 degree C). Treat with IV fluids.
- check for electrolyte abnormalities especially hyponatraemia - this will increase the risk of cerebral oedema
- keep blood glucose normal

Prophylactic antibiotics are often given after immersion in severely contaminated water. Fever is common during the first 24 hours but is not necessarily a sign of infection. Gram-negative organisms, especially *Pseudomonas aeruginosa*, are common and *Aspergillus* species have been reported. When an infection is suspected broad-spectrum intravenous antibiotic therapy (such as cefotaxime) should be started after blood and sputum cultures (when possible).

Do not discontinue resuscitation until core temperature is at least 32 degree C or cannot be raised.

Failure to restore an adequate circulation after 30 minutes of resuscitation after re-warming to 32-35 degree C makes further efforts unlikely to be successful.

The pregnant woman or girl or child suffering envenomation

Diagnosis and Initial Assessment

- assess ABCD: shock is common in viper bites
- endotracheal intubation and assisted ventilation if available and sustainable are indicated for bulbar palsy and paralysis of intercostal muscles and diaphragm (alternatively prolonged bag/mask ventilation – possibly in rotation by family members)
- look for signs of bleeding
- look for early signs of neurotoxicity: ptosis, limb weakness, or difficulties in talking, swallowing or breathing
- check for muscle tenderness and myoglobinuria in sea-snake bites
- take blood for Hb, WCC and platelet count; prothrombin time, APTT and fibrinogen levels (if available); urea and creatinine; creatine phosphokinase (if available)
- if sophisticated clotting studies are unavailable, perform the 20 minute whole blood clotting test (WBCT20):

- place a few ml of freshly sampled blood in a new, clean, dry glass tube or bottle
- leave undisturbed for 20 minutes at ambient temperature
- tip vessel once
- If blood is still liquid (unclotted) and runs out, patient has hypofibrinogenaemia ('incoagulable blood') as a result of venom-induced consumption coagulopathy
- perform on admission and repeat 6 hours later

Further Management

- observe in hospital for at least 24 hours - envenoming can develop rapidly after latent period
- give antivenom if there are signs of envenoming; ideally type specific and have adrenaline available for possible anaphylaxis. Children require exactly the same dose as adults (dose is dependent upon amount of venom injected, not bodyweight). Dilute antivenom in two to three volumes of 5% glucose or Ringer Lactate or Hartmann's solution or 0.9% saline and infuse over 45 min to an hour. Infusion rate should be slow initially and gradually increased. Note: doses of antivenom vary considerably, follow instructions enclosed with the antivenom.
- fasciotomy is needed if there is clinical evidence of raised intra-compartmental pressure
- correct any coagulopathy as soon as possible using fresh blood if available and vitamin K 300 micrograms/kg IV
- if venom has been spat in the eyes, eg cobras, irrigate rapidly with water; adrenaline 0.5% drops may help reduce pain and inflammation
- avoid IM injections and invasive procedures in patients with incoagulable blood
- give tetanus prophylaxis
- excise any necrotic tissue

In scorpion stings

Control pain with infiltration of 1% lignocaine around wound or systemic morphine. Prazosin is effective for treating hypertension and cardiac failure (5-15 micrograms/kg two to four times a day increasing to control blood pressure to a maximum of 500 micrograms/kg/day for under 12 years and 20 mg/kg/day over 12 years). The patient should be lying down for the first four to six hours of treatment in case of a sudden fall in blood pressure.

The pregnant woman or girl or child who has ingested drugs or poisons

Introduction

- in poor countries the most commonly ingested poisons are kerosene and caustic solutions
- self-harm is a major cause in adolescents and in pregnant women or girls
- most accidental ingestions are non-toxic and deaths are uncommon
- accidental poisoning is most common aged 18-36 months: ask specifically about access to prescribed drugs, household substances etc.
- many die from inhalation of carbon monoxide and other gases in household fires
- traditional remedies can sometimes be highly toxic
- alcohol and solvent abuse are common
- occasionally an adult will deliberately poison a child. It is necessary to have a high index of suspicion in such cases as the history of poisoning will not be given
- some drugs are particularly dangerous in overdose e.g. quinine, diphenoxylate with atropine and tricyclic anti-depressants

Pathway of Care Poisoning in a child

Safe approach	- remove from inhaled poison care with chemicals such as organophosphates (external decontamination)
Airway	- if consciousness depressed GCS <8 or P or U (AVPU) assume compromised protect airway by recovery position and intubation if possible
Breathing	- consider high concentration of oxygen (especially CO poisoning even if pink) give rescue breaths if necessary
Circulation	- treat shock and arrhythmias
Disability	- check blood glucose/give IV/NG glucose (5ml/Kg 10% glucose) check pupils – dilated suggests amphetamines, atropine, tricyclic antidepressants, constricted suggests opiates or organophosphates
Posture	- hypertonia suggests amphetamines, ecstasy or tricyclic antidepressant poisoning
Convulsions	- suggests hypoglycaemia (alcohol), tricyclic antidepressants or some insecticides
Exposure	- look for injection sites core temperature



Emergency treatment

- drink milk or water urgently after caustic substances
- naloxone if opiate suspected (10micrograms/Kg IV repeated every 2-3 minutes to maximum dose of 2mg)
- consider phenytoin if tricyclic antidepressant poisoning (15-20mg/Kg IV infusion over 30 minutes then 2.5 to 7.5mg/Kg 12 hourly)
- consider sodium bicarbonate 1 mmol/kg in tricyclic poisoning



Drug elimination

- activated charcoal 1g/Kg urgent (not useful alcohol or iron) and repeat after 4 hours

-gastric lavage (for high lethality ingestions) 10 – 20 ml/kg 0.9% saline aliquots
NOT after corrosives or petroleum products

If charcoal is not available and a potentially life-threatening dose of poison has been taken (particularly of iron), give paediatric ipecacuanha (10 mL for those aged six months to two years and 15 mL for over two years plus a glass of water) to induce vomiting. Do not give ipecacuanha if the child has a decreasing level of, or impaired, consciousness. Do NOT give if corrosive solutions have been ingested or if kerosene, turpentine or petrol have been ingested as they could be inhaled following vomiting resulting in lipid pneumonia.

Pathway of Care Poisoning in pregnancy

Assess: Safe approach – remove from inhaled poison

- Airway - care with chemicals such as organophosphates (external decontamination)
- if consciousness depressed GCS <8 or P or U (AVPU) assume compromised
protect airway by recovery position and intubation if available
- Breathing - consider high concentration of oxygen (especially CO poisoning even if pink)
give rescue breaths if necessary
- Circulation - treat shock and arrhythmias
- Disability - check blood glucose/give IV/NG glucose (5ml 50% glucose)
check pupils – dilated suggests amphetamines, atropine, tricyclic
antidepressants, constricted suggests opiates or organophosphates
- Posture - hypertonia suggests amphetamines, ecstasy or tricyclic antidepressant
poisoning
- Convulsions - suggests hypoglycaemia (alcohol), tricyclic antidepressants or some
insecticides
- Exposure - look for injection sites
-measure core temperature



Emergency treatment

- drink milk or water urgently after caustic substances
- naloxone if opiate suspected (0.8-2mg IV repeated every 2-3 minutes to maximum
dose of 10mg)
- consider phenytoin if tricyclic antidepressant poisoning (15-20mg/Kg IV infusion over
30 minutes-not exceeding a dose rate of 50mg/minute then 2.5 to 7.5mg/Kg 12 hourly)



Drug elimination – activated charcoal 50 grams urgent (not useful in alcohol or iron
poisoning) repeat after 4 hours

OR

Gastric lavage (for high lethality ingestions such as iron) 250ml 0.9% Saline aliquots
NOT after corrosives or petroleum products

Airway protection essential if impaired consciousness

Post operative care for pregnant women or girls undergoing surgery for obstetric emergencies

Basic nursing issues

The patient should be discharged to the ward or recovery area with clear "orders" for the following:

- **Monitor ABC**
 - If unconscious (P or U on AVPU scale), the patient should not be left alone until responding to voice, recovery position and airway opening as required
 - Vital signs (T,P,Respiratory rate and BP and capillary refill time every 15 minutes for first one hour, hourly for 4 hours and then 2 hourly. Observations should be more often if there is a change in observation from a normal to abnormal value.)
 - Monitor SaO₂ (normal > 93 %) after a general anesthetic. Give **oxygen** as required until SaO₂ is >93% in air or patient's colour normal. Remember cyanosis may not be present if severely anaemic.
 - Observe the pregnant woman or girl closely until the effect of the anaesthetic has worn off.
 - Control pain: if severe need IV morphine
 - Rate and type of intravenous fluid (if ketosis ensure adequate amount of glucose in drip)
 - Urine output, and surgical/NG drainage/vomiting
 - Record Input versus Output and calculate difference every 12 hours
 - Other medications
 - Laboratory investigations

The patient's progress should be monitored and should include at least:

- A comment on medical and nursing observations
- A specific comment on the wound or operation site
- Any complications
- Any changes made in treatment.

Prevention of complications

- Provide adequate pain control
- Encourage early mobilization:
 - Deep breathing and coughing
 - Active daily exercise
 - Joint range of motion
 - Muscular strengthening
 - Make walking aids such as canes, crutches and walkers available and provide instructions for their use
- Ensure adequate nutrition
- Prevent skin breakdown and pressure sores:
 - Turn the patient frequently
 - Keep urine and faeces off skin

Pain management (see section 4)

Manage pain wherever you see patients (emergency, operating room and on the ward) and anticipate their needs for pain management after surgery and discharge. Do not unnecessarily delay the treatment of pain.

Section 19 Post operative care

In the first 12-24 hours after a major surgical procedure, such as Caesarean Section, there will be need for powerful opiate analgesia (usually morphine IV-see section 4 for details). Thereafter, the pain should be less severe and regular codeine, non-steroidals, aspirin or paracetamol should be sufficient.

Monitoring

All patients should be assessed at a frequency determined by how ill they are, and even those who are not seriously ill must be regularly assessed.

Vital signs (temperature, pulse and respiratory rate, BP, urine output and fluid inputs, should be recorded on a standard form or graph at least 4 hourly for 24 hours after the immediate post-operative recovery phase.

Do not forget anti-tetanus coverage when appropriate.

Progress notes need not be long, but must comment on the patient's condition and note any changes in the management plan. They should be signed by the person writing the note.

Notes can be organized in the "SOAP" format:

Subjective: how the patient feels

Objective: findings on physical examination, vital signs and laboratory results

Assessment: what the health worker thinks

Plan: management plan; this may also include directives which can be written in a specific location as "orders".

Specific post-operative issues

Post salpingectomy for ruptured ectopic pregnancy

- Counsel not to use IUCD.
- Early ultrasound as soon as new pregnancy suspected.
- If pregnancy is interstitial and cavity is opened, subsequent pregnancies at risk of uterine rupture.
- Offer child spacing/family planning advice

Post Caesarean Section

- Palpate the uterine fundus to ensure that the uterus remains contracted.
- Check for excessive PV loss
- Bowel function should be normal after 12 hours
- If uncomplicated, give liquids after 4 hours and solids when passing gas per rectum
- If infected, obstructed labour or uterine rupture, wait until bowel sounds before giving oral fluids
- Keep dressing on wound for 24 hours to ensure re-epithelialisation.
- If blood is leaking, reinforce dressing or replace with new one if more than half soaked
- *If bleeding occurs:*
 - Massage the uterus to expel blood and blood clots. Presence of blood clots will inhibit effective uterine contractions;

Section 19 Post operative care

- Give oxytocin 5 units IV and then infuse 40 units in 500ml IV fluids (normal saline or Ringer-Lactate or Hartmann's) over 4 hours. If bleeding is heavy give misoprostol rectally 4 x 200 microgram tablets
- **If there are signs of infection** or the mother **currently has fever**, give a combination of antibiotics until she is fever-free for 48 hours: - ampicillin 2 g IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours. **If fever is still present 72 hours after initiating antibiotics**, re-evaluate and revise diagnosis.
- Infection of the uterus is a major cause of maternal death. Delayed or inadequate treatment of metritis may result in pelvic abscess, peritonitis, septic shock, deep vein thrombosis, pulmonary embolism, chronic pelvic infection with recurrent pelvic pain and dyspareunia, tubal blockage and infertility.
- If **retained placental fragments** are suspected, perform a digital exploration of the uterus to remove clots and large pieces. Use ovum forceps or a large curette if required.
- If there is **no improvement** with conservative measures and there are **signs of general peritonitis** (fever, rebound tenderness, abdominal pain), perform a Laparotomy to drain the pus.
- If the **uterus is necrotic and septic**, perform subtotal hysterectomy.
- If the pregnant woman or girl is **significantly anaemic**, Hb < 6- 7g/dl, then transfusion may help recovery from the operation. If possible, consider 500ml of fresh cross matched blood from a relative.
- Remove catheter after 8 hours if urine is clear; if not wait until it is.
- Wait 48 hours before removing catheter if: uterine rupture, prolonged or obstructed labour, massive perineal oedema, puerperal sepsis with pelvic peritonitis
- If bladder was damaged leave it in for 7 days and until urine is clear. If not receiving antibiotics: give nitrofurantoin 100mg orally once daily until catheter removed.

Wound abscess

- If there is **pus or fluid**, open and drain the wound. Remove infected skin or subcutaneous sutures and debride the wound. Do not remove fascial sutures.
 - If there is an **abscess without cellulitis**, antibiotics are not required.
 - Place a damp sterile normal saline dressing in the wound and change the dressing every 24 hours.
 - Advise on good hygiene and to wear clean pads or cloths that are changed frequently.
- **If infection is superficial and does not involve deep tissues, monitor for development of an abscess and give antibiotics:**
ampicillin 500 mg by mouth four times per day for 5 days; - PLUS metronidazole 400 mg by mouth three times per day for 5 days.
- **If the infection is deep, involves muscles and is causing necrosis (necrotizing fasciitis), give antibiotics until necrotic tissue has been removed and fever-free for 48 hours:**
penicillin G 2 million units IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours;
- **Once fever-free for 48 hours, give:**
ampicillin 500 mg by mouth four times per day for 5 days; - PLUS metronidazole 400 mg by mouth three times per day for 5 days.

Section 19 Post operative care

- **Note:** Necrotizing fasciitis requires wide surgical debridement. Perform secondary closure 2–4 weeks later, depending on resolution of infection.

Next pregnancy Inform mother on discharge that she is at risk of uterine rupture during next pregnancy. Offer child spacing/family planning advice

Post uterine inversion

Once the inversion is corrected, infuse IV oxytocin 40 units in 500 ml normal saline or Ringer-Lactate or Hartmann's over 4 hours:

- If the **uterus does not contract after oxytocin**, give misoprostol rectally 4 x 200 microgram tablets

Give a single dose of prophylactic antibiotics after correcting the inverted uterus:
- ampicillin 2 g IV PLUS metronidazole 500 mg IV; - **OR** cefazolin 1 g IV PLUS metronidazole 500 mg IV.

If there are **signs of infection** or the mother **currently has fever**, give a combination of antibiotics until she is fever-free for 48 hours: - ampicillin 2 g IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours.

Post symphysiotomy

- If **there are signs of infection** or the mother currently has fever, give a combination of antibiotics until she is fever-free for 48 hours: - ampicillin 2 g IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours.
- Apply elastic strapping across the front of the pelvis from one iliac crest to the other to stabilize the symphysis and reduce pain.
- Leave the catheter in the bladder for a minimum of 5 days.
- Encourage the mother to drink plenty of fluids to ensure a good urinary output.
- Encourage bed rest for 7 days after discharge from hospital.
- Encourage the mother to begin to walk with assistance when she is ready to do so.
- If long-term walking difficulties and pain are reported (occur in 2% of cases), treat with physical therapy.

Post manual removal placenta

- Observe the mother every 15 minutes until the effect of IV sedation or anaesthetic has worn off.
 - Monitor the vital signs (pulse, blood pressure, respiration) every 30 minutes for the next 6 hours or until stable.
 - Palpate the uterine fundus to ensure that the uterus remains contracted.
 - Check for excessive lochia.
 - Continue infusion of IV fluids.
 - Transfuse as necessary.

Peritonitis

Provide nasogastric suction.
Infuse IV fluids.

Section 19 Post operative care

Give antibiotics until fever-free for 48 hours: - ampicillin 2 g IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours.

If necessary, perform laparotomy.

Pelvic abscess

Give antibiotics before draining the abscess and continue until fever-free for 48 hours: - ampicillin 2 g IV every 6 hours; - PLUS gentamicin 5 mg/kg body weight IV every 24 hours; - PLUS metronidazole 500 mg IV every 8 hours.

If the abscess is **fluctuant in the cul-de-sac**, drain the pus through the cul-de-sac-culdocentesis. If the **spiking fever continues**, perform a laparotomy.

Care of the patient after Spinal Anaesthesia

Observations

Standard post anaesthetic observations

Sensation should return within 4 hours. If after 4 hours the patient remains numb and/or cannot move their legs, contact the anaesthetist urgently.

Analgesia

Severe pain may return suddenly when the spinal block has worn off. Give analgesia when patient first has pain.

Fasting

Fasting is not needed unless it is a surgical requirement eg after abdominal operations

Posture

The patient does not have to lie flat. Allow to sit up as soon as they are able

Mobilising

If not contraindicated by the surgery, the patient can get out of bed 2 hours after the return of normal sensation, ONLY WITH ASSISTANCE. Before getting the patient out of bed sit her up slowly. If the patient feels faint, dizzy or sick then lie the patient down, take the blood pressure and inform anaesthetist.

Potential complications

Postural hypotension

Lie the patient on the bed, give or increase IV fluids and inform anaesthetist.

Urinary Retention

Encourage patient to pass urine when sensation returns. If the patient has not passed urine and she has a palpable bladder, she may need a catheter.

Appendix

Normal values for vital clinical signs

Symptoms and signs for evaluating a patient in hospital

Is the patient alert, sleepy, irritable?

Is there an increased breathing rate?

Is there a rapid/ slow heart rate – is the pulse weak? Is it bounding?

Examine depth of breathing – is it shallow?

Is breathing noisy? stridor, wheezing, grunting?

Is there nasal flaring (nares moving in and out with breathing)?

Is there tracheal tug (marked inward movement at trachea when breathing) or the use of accessory muscles to help breathe or intercostal/subcostal recession?

Is the skin mottled?

Look at colour of skin, lips, nail beds for cyanosis

Check for capillary refill time

Check O2 saturations if possible

For patients with possible anaemia

Is there tiredness/lethargy?

Is there pallor of the skin, mucous membranes, gums, insides of eyelids, fingernails?

Is there shortness of breath?

Are the stools black? Blood or on iron supplements?

For patients with blood clotting disorders

Are there bleeding gums when eating/brushing teeth?

Are there nose bleeds?

Is there excessive bruising?

Is there bruising in unexpected places (consider non accidental injury)?

Are there petechiae? (tiny, flat, red or purple spots on skin or mucous membranes caused by local haemorrhage)

Estimating the weight of a child

Infant = up to 12 months old

- Birth weight - doubles by five months
- triples by one year
- quadruples by two years

After 12 months, the formula below can be applied, but may need to be modified according to whether the child is small or large compared with the average

$$\text{Weight (kg)} = 2 (\text{age in years} + 4)$$

Normal vital signs

Normal vital signs by age in a child and pregnant woman or girl

<u>Age (years)</u> <u>(bpm)</u>	<u>Heart rate (bpm)</u>	<u>Systolic BP (mmHg)</u>	<u>Respiratory rate</u>
<1	110-160	70-90	30-40
1-2	100-150	80-95	25-35
2-5	95-145	80-100	25-30
5-12	80-120	90-110	20-25
>12	60-100	100-120	15-20
Pregnancy	65-115	90-120	10-29

Awake and asleep heart rates

<u>Normal heart rates at age:</u>	<u>awake</u>	<u>asleep</u>
Newborn – 3 month	90 – 190	80 - 160
3 month to 2 yr	80 – 150	70 – 120
2 to 10 yr	70 – 120	60 - 90
10 yr – adult	55 – 90	50 – 90

Systolic and diastolic blood pressures

<u>Normal blood pressure at age:</u>	<u>Systolic</u>	<u>Diastolic</u>
Birth (12 hr, 3kg)	50-70	25-45
Neonate (96 hr)	60-90	20-60
Infant	87-105	53-66
2-4 years	95-105	53-66
7 years	97-112	57-71
15 years	112-128	66-80

Blood pressure is difficult to measure and interpret in infants and children under five years of age. Do not base decisions to treat hypertension on the results of electronic sphygmomanometers, they can be inaccurate. Always check with a hand pumped machine.

A quick formula for calculating normal systolic pressure in children is:

Normal systolic blood pressure in children = $80 + (2 \times \text{age in yrs})$

Capillary refill time

The normal capillary refill time (CRT) is up to three (3) seconds. Be aware that in colder environments peripheral CRT is not a reliable test for perfusion.

Urine output

- Infants 2 mL / kg / hr
- Child 1 mL / kg /hr
- Pregnant adult >30 mL/hour or >100 mL every 4 hours (WHO)

Normal core (oral) body temperatures

Infant: 36.5 – 37.5 deg C 97.7 – 99.5 deg F

Child: 36.0 – 37.2 deg C 96.8 – 98.6 deg F

Circulating blood volume

- 100 ml / kg at birth
- 80 ml / kg at 1 year
- 70 ml / kg at 12 years
- 100 ml / kg in pregnancy

Disability

- A - ALERT
- V - Responds to VOICE
- P - Responds to PAIN = Glasgow Coma score 8 or less
- U - UNRESPONSIVE

Blood glucose conversion 1 mmol/litre =19 mg/dl

Drop factor for IV infusions

Fluids can be calculated in drops/minute as follows. First identify from the IV giving set what the “drop factor” is (standard giving sets vary between 10, 15 and 20 drops = 1ml). For micro-drop systems, which often accompany giving sets with burettes, 1ml = 60 drops. When setting the infusion rate with the flow controller on the giving set below the chamber where the drops occur, always set and count the rate over a full 1 minute.

Calculating drip rates for a standard giving set with a drop factor of 20 drops/mL

- 1 ml = 20 drops in standard giving set
- drops / min = ml / hr divided by 3

Normal values for laboratory measurements

Haematology: normal laboratory values

Haemoglobin

Age	Haemoglobin in g/dL
1 – 3 days	14.5 – 22.5 g/dL
2 weeks	14.5 – 18.0 g/dL
6 months	10.0 – 12.5 g/dL
1 – 5 yr	10.5 – 13.0 g/dL
6 – 12 yr	11.5 – 15.0 g/dL
12 – 18 yr	male 13.0 – 16.0 g/dL female 12.0 – 16.0 g/dL

Platelets

Newborn	84 – 478	109/L
Child	150 – 400	109/L

White blood cells (WBC) and erythrocyte sedimentation rate (ESR)

	Age	Values
ESR	All ages	0-10 mm/hour
WBC	1-2 days	9.0 - 34.0 x 10 ⁹ /L
	Neonate	6.0 – 19.5 x 10 ⁹ /L
	1 – 3 yr	6.0 – 17.5 x 10 ⁹ /L
	4 – 7 yr	5.5 – 15.5 x 10 ⁹ /L
	8 – 13 yr	4.5 – 13.5 x 10 ⁹ /L
	13 yr +	4.5 – 11.0 x 10 ⁹ /L

Lymphocytes over one year Median 4.1 – 6.0 x 10⁹/L

Chemistry: normal laboratory values

Substance	Age	Value range
Albumin	Preterm	18 – 30 g/L
	Full term to 7 days	25-34 g/L
	< 5 years	39 – 50 g/L
	5 – 19 years	40 – 53 g/L
Amylase	All ages	30 – 100 units/L
ASO titre	2 – 5 years	120 – 160 Todd units
	6 – 9 years	240 Todd units
	10 – 12 years	320 Todd units
Bicarbonate	All ages	Arterial: 21 – 28 mmol/L
		Venous: 22 – 29 mmol/L
Bilirubin (conjugated)	> 1 year	0 – 3.4 micromol/L
Calcium	0-24 hours	2.3 – 2.65 mmol/L (1.07 – 1.27 ionised)
	24 hours to 4 days	1.75 – 3.00 mmol/L (1.00 – 1.17 ionised)
	4 – 7 days	2.25 – 2.73 mmol/L (1.12 – 1.23 ionised)
	child	2.15 - 2.70 mmol//L (1.12 – 1.23 ionised)
Chloride	Neonate	97 – 110 mmol/L
	Child	98 – 106 mmol/L
Creatinine	neonate	27- 88 micromol/L
	infant	18 – 35 micromol/L
	child	27 – 62 micromol/L

Section 20 Appendix

Glucose	preterm neonate	1.4 – 3.3 mmol/L
	0 – 24 hours	2.2 – 3.3 mmol/L
	infant	2.8 – 5.0 mmol/L
	child	3.3 – 5.5 mmol/L
Magnesium	0 – 7 days	0.48 – 1.05 mmol/L
	7 days – 2 years	0.65 – 1.05 mmol/L
	2 – 14 years	0.60 – 0.95 mmol/L
Osmolarity	child	276 – 295 mosmol/L (serum)
Potassium	<2 months	3.0 – 7.0 mmol/L
	2-12 months	3.6 – 6.0 mmol/L
	child	3.5 – 5.0 mmol/L
Sodium	neonate	136 – 146 mmol/L
	Infant	139 – 146 mmol/L
	child	138 – 146 mmol/L
Urea	neonate	1.0 – 5.0 mmol/L
	infant	2.5 – 8.0 mmol/L
	child:	2.5 – 6.6 mmol/L

Oxygen saturation SpO₂

95% - 100% (depends on altitude and corrections will be needed for those living > 1000 metres above sea level. The following table gives saturation levels in a number of differing geographical locations above sea level.)

SpO₂ levels at different altitudes

Altitude (m)	Location	N studied	Age	SpO ₂ (%)	Author	Year
Sea level	UK	70	2-16 years Mean 8 yrs	Range 95.8-100 Median 99.5	Poets et al	1993
Sea level	Peru	189	2 m-5yrs	Range 96-100 Mean 98.7	Reuland Et al	1991
1610	colorado	150	<48hrs 3 months	95% CI 88-97 Mean 93 95% CI 86-97 Mean 92.2	Thilo et al	1991
1670	nairobi	87	7days-3 yrs	Range 89.3-99.3 Mean 95.7	Onyango Et al	1993
2640	bogota	189	5 days-2 yrs	Range 84-100 Mean 93.3	Lozano et al	1992
2800	colorado	72	3-670 days	Range 88-97 Mean 91.7	Nicholas Et al	1993
3100	colorado	14	6hrs-4 months 1 week 4 months	Range 81-91 Mean 80.6 +/- 5.3 Mean 86.1+/- 4.6	Niemeyer Et al	1993
3658	Tibet*	15	6hrs – 4 Months	Immigrant 76-90 Indigenous 86-94	Niemeyer Et al	1995
3750	peru	153	2 -60 months	Range 81-97 Mean 88.9	Reuland Et al	1991

Notes: Values given are those in quiet sleep.

*ranges born to immigrant Chinese mothers and for those indigenous babies whose families have lived at that altitude for innumerable generations

Blood gases (normal arterial range)

pH 7.35 – 7.45

PCO₂ 4.5 – 6 kPa (35 -45 mmHg)

PO₂ 10 – 13 kPa (75 – 98 mmHg)

Airway equipment values

Un-cuffed tubes in children < 25 kg weight (aged six to seven years)

Endotracheal tubes (internal diameter mm)

- Full term baby size 3.0 – 3.5

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- Infant (< 1year) size 4.0 – 4.5
- Over 1 year size of tube = Age / 4 + 4

Length of endotracheal tube

Age DIVIDED BY 2 + 12 cm (oral tube)
+ 14 cm (nasal tube)

Fluid and electrolyte management

a) Normal requirements for fluid

Blood volume is about 100 mL/kg at birth falling to about 80 mL/kg at one year. Total body water varies from 800 mL/kg in the neonate to 600 mL/kg at one year and thereafter. Of this about two thirds (400 mL/kg) is intracellular fluid, the rest being extra cellular fluid. Thus initial expansion of vascular volume in a state of shock can be achieved with relatively small volumes of fluid: 20 mL/kg (a quarter of the blood volume) will usually suffice. However, this volume is only a fraction of that required to correct dehydration as the fluid has been lost from all body compartments in this condition. Clinically, dehydration is not detectable until above 3 to 5% (30-50mL/kg) of the body fluid has been lost.

It is important to remember that while fluid must be given quickly to correct loss of circulating fluid from the blood compartment (shock – except in malnutrition where it must be given slowly in dehydration).

Note: Fluids in neonates after the first three days of life are often prescribed upon the basis of 150 mL/kg/day but this is not related to fluid needs but is merely the volume of standard formula milk required to give an adequate protein and calorie intake.

Fluid requirement can be divided into four types:

1. For replacement of insensible losses through sweat, respiration, gastrointestinal loss etc.
2. For replacement of essential urine output, the minimal urine output to allow excretion of the products of metabolism etc.
3. Extra fluid to maintain a modest state of diuresis.
4. Fluid to replace abnormal losses such as blood loss, severe diarrhoea, diabetic polyuria losses etc.

A formula for calculating normal fluid requirement is given in table below. It is useful because it is simple, can be applied to all age ranges and is easily subdivided. The formula gives total fluid requirements, that is, types 1 + 2 + 3 above.

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Body weight	Fluid /24 hrs	Fluid/hr	Na K mmol/24 hours/kg		Energy kcal/24hrs	Protein g/24hrs
First 10 kg	100 mL	4 mL	2-4	1.5-2.5	110	3
Second 10 kg	50 mL	2 mL	1-2	0.5-1.5	75	1
Subsequent kg	20 mL	1 mL	0.5-1	0.2-0.7	30	0.75

For examples: 6 kg infant would require 600 mL per day
 14 kg child would require 1000 + 200 = 1200 mL per day
 25 kg child would require 1000 + 500 + 100 = 1600 mL per day

Or the following table can be used.

Weight of child	Fluid in mL/day
<10 kg	100/kg
10-19 kg	50/kg
>20 kg	20/ kg
For example mL/day	
2 kg	220
4 kg	440
6 kg	660
8 kg	900
10 kg	1100
12 kg	1300
14 kg	1400
16 kg	1600
18 kg	1700
20 kg	1800
22 kg	1900
24 kg	2000

In practice, the well child just drinks when thirsty, but it is useful to have an idea of how much fluid a child should be expected to need. Of course, if there are excess losses as in diarrhoea or fever or the ambient temperature is especially high leading to high insensible losses, then more fluid is required. Except in cardiac or renal disease, a good check on whether a child is having enough fluid is to see if they have a satisfactory urine output of at least 2 mL/kg/hour.

Average fluid requirements in pregnancy are: 1500 to 2500 mL/day. This depends on levels of activity, ambient temperature and whether or not there is a fever. Up to 6000 mL/day may be required.

Rehydration

Fluid deficit + normal fluid requirements + additional losses (sweat, diarrhoea, vomit etc)

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Fluid deficit (mL) = % dehydration x weight (kg) x 10

On-going losses

- After each loose stool
- age < 2 yrs; 50m – 100 ml
- age ≥2 yrs ; 100-200 ml
- After each vomit – 2ml / kg body weight

Some useful information regarding biochemical measurements

1. Percentage solution = grams in 100 mL e.g. 10% dextrose = 10g in 100 mL

2. One millimole = molecular weight in milligrams

3. Some atomic weights:

hydrogen	1.0
carbon	12.0
nitrogen	14.0
oxygen	16.0
sodium	23.0
phosphorus	31.0
chlorine	35.5
potassium	39.1
calcium	40.1

therefore for example:

1mmol NaCl	= 58.5 mg
1mmol NaHCO ₃	= 84 mg
1mmol KCl	= 74.6 mg

4. The equivalent weight of an electrolyte = molecular weight/valency e.g. Ca = 40/2

5. Useful figures to know:

30% NaCl	= 5 mmol/mL each of Na and Cl
0.9% NaCl	= 0.154 mmol/mL each of Na and Cl

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15% KCl (15g/100mL) = 2 mmol/mL each of K and Cl (also called concentrated or strong KCl)

10% Ca Gluconate (10g/100mL) = 0.225 mmol/mL

(note 1mL of CaCl 10% is equivalent to 3mL of Ca gluconate 10%)

8.4% NaHCO₃ = 1 mmol Na and 1mmol HCO₃ /mL

1 mL/h N saline = 3.7 mmol Na in 24h

6 Serum osmolarity= 2(Na + K) + glucose + urea (normally 285 – 295 mosmols/L)

Normal requirements for electrolytes (unless excessive losses)

There are obligatory losses of electrolytes in stools, urine, and sweat, and these require replacement. Any excess is simply excreted in the urine.

Electrolyte contents of body fluids

Fluid	Na (mmol/L)	K (mmol/L)	Cl (mmol/L)	HCO ₃ mmol/L
Plasma	135-141	3.5-5.5	100-105	24-28
Gastric	20-80	5-20	100-150	0
Intestinal	100-140	5-15	90-130	13-65
Diarrhea	7-96	34-150	17-164	0-75
Sweat	<40	6-15	<40	0-10

Normal daily water, electrolyte, energy and protein requirements in children

Body weight	Water mL/kg/day	Sodium (Na) mmol/kg/day	Potassium (K) mmol/kg/day	Energy kcals/day	Protein g/day
First 10 kg	100	2-4	1.5-2.5	110	3.00
Second 10kg	50	1-2	0.5-1.5	75	1.50
Subsequent kg	20	0.5-1	0.2-0.7	30	0.75

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Normal water and electrolyte requirements in pregnancy

Maintenance requirements/24 hours	Fluid/day	Sodium (mmol/day)	Potassium (mmol/day)
	1500-2500mL	150	100

Commonly available crystalloid fluids

Fluid	Na+ (mmol/L)	K+ (mmol/L)	Cl- (mmol/L)	Energy (kcal/L)
<i>Isotonic crystalloid fluids</i>				
Saline 0.9% (normal)	150	0	150	0
Glucose 5% (50mg/mL)	0	0	0	200
Hartmann's solution or Ringer's lactate **	131	5	111	0
<i>Hypertonic crystalloid fluids</i>				
Saline 0.45% glucose 5%	75	0	75	200
Glucose 10% (100mg/mL)	0	0	0	400
Glucose 50%	0	0	0	2000

** Hartmann's or Ringer's lactate also has HCO₃⁻ as lactate 29mmol/L and calcium 2 mmol/L

Commonly available colloid fluids

Colloid	Na+ (mmol/l)	K+ (mmol/l)	Ca++ (mmol/l)	Duration of action (hours)	Comments
Albumin 4.5%	150	1	0	6	Protein buffers
Gelofusin	154	<1	<1	3	Gelatine
Haemaccel	145	5	12.5	3	Gelatine
Pentastarch	154	0	0	7	Hydroxyethyl starch

Table weight to body surface area (Boyd's calculation)

Weight Kg	SA m2	Weight Kg	SA m2	Weight Kg	SA m2
0.7	0.07	12	0.56	38	1.23
1.0	0.10	13	0.59	40	1.27
1.6	0.14	14	0.62	42	1.32
2.0	0.16	15	0.65	44	1.36
2.6	0.19	16	0.68	46	1.40
3.0	0.21	17	0.71	48	1.44
3.6	0.24	18	0.74	50	1.48
4.0	0.26	19	0.77	52	1.52
4.5	0.28	20	0.79	54	1.56
5.0	0.30	22	0.85	56	1.60
5.5	0.33	24	0.90	58	1.63
6.0	0.35	26	0.95	60	1.67
7.0	0.38	28	1.00	65	1.76
8.0	0.42	30	1.05	70	1.85
9.0	0.46	32	1.09	75	1.94
10.0	0.49	34	1.14	80	2.03
11.0	0.53	36	1.19	90	2.19

Weight-for-Length Reference Card (below 87 cm)

Boys' weight (kg)					Length	Girls' weight (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Médian	(cm)	Médian	-1 SD	-2 SD	-3 SD	-4 SD
1.7	1.9	2.0	2.2	2.4	45	2.5	2.3	2.1	1.9	1.7
1.8	2.0	2.2	2.4	2.6	46	2.6	2.4	2.2	2.0	1.9
2.0	2.1	2.3	2.5	2.8	47	2.8	2.6	2.4	2.2	2.0
2.1	2.3	2.5	2.7	2.9	48	3.0	2.7	2.5	2.3	2.1
2.2	2.4	2.6	2.9	3.1	49	3.2	2.9	2.6	2.4	2.2
2.4	2.6	2.8	3.0	3.3	50	3.4	3.1	2.8	2.6	2.4
2.5	2.7	3.0	3.2	3.5	51	3.6	3.3	3.0	2.8	2.5
2.7	2.9	3.2	3.5	3.8	52	3.8	3.5	3.2	2.9	2.7
2.9	3.1	3.4	3.7	4.0	53	4.0	3.7	3.4	3.1	2.8
3.1	3.3	3.6	3.9	4.3	54	4.3	3.9	3.6	3.3	3.0
3.3	3.6	3.8	4.2	4.5	55	4.5	4.2	3.8	3.5	3.2
3.5	3.8	4.1	4.4	4.8	56	4.8	4.4	4.0	3.7	3.4
3.7	4.0	4.3	4.7	5.1	57	5.1	4.6	4.3	3.9	3.6
3.9	4.3	4.6	5.0	5.4	58	5.4	4.9	4.5	4.1	3.8
4.1	4.5	4.8	5.3	5.7	59	5.6	5.1	4.7	4.3	3.9
4.3	4.7	5.1	5.5	6.0	60	5.9	5.4	4.9	4.5	4.1
4.5	4.9	5.3	5.8	6.3	61	6.1	5.6	5.1	4.7	4.3
4.7	5.1	5.6	6.0	6.5	62	6.4	5.8	5.3	4.9	4.5
4.9	5.3	5.8	6.2	6.8	63	6.6	6.0	5.5	5.1	4.7
5.1	5.5	6.0	6.5	7.0	64	6.9	6.3	5.7	5.3	4.8
5.3	5.7	6.2	6.7	7.3	65	7.1	6.5	5.9	5.5	5.0
5.5	5.9	6.4	6.9	7.5	66	7.3	6.7	6.1	5.6	5.1
5.6	6.1	6.6	7.1	7.7	67	7.5	6.9	6.3	5.8	5.3
5.8	6.3	6.8	7.3	8.0	68	7.7	7.1	6.5	6.0	5.5
6.0	6.5	7.0	7.6	8.2	69	8.0	7.3	6.7	6.1	5.6
6.1	6.6	7.2	7.8	8.4	70	8.2	7.5	6.9	6.3	5.8
6.3	6.8	7.4	8.0	8.6	71	8.4	7.7	7.0	6.5	5.9
6.4	7.0	7.6	8.2	8.9	72	8.6	7.8	7.2	6.6	6.0
6.6	7.2	7.7	8.4	9.1	73	8.8	8.0	7.4	6.8	6.2
6.7	7.3	7.9	8.6	9.3	74	9.0	8.2	7.5	6.9	6.3
6.9	7.5	8.1	8.8	9.5	75	9.1	8.4	7.7	7.1	6.5
7.0	7.6	8.3	8.9	9.7	76	9.3	8.5	7.8	7.2	6.6
7.2	7.8	8.4	9.1	9.9	77	9.5	8.7	8.0	7.4	6.7
7.3	7.9	8.6	9.3	10.1	78	9.7	8.9	8.2	7.5	6.9
7.4	8.1	8.7	9.5	10.3	79	9.9	9.1	8.3	7.7	7.0
7.6	8.2	8.9	9.6	10.4	80	10.1	9.2	8.5	7.8	7.1
7.7	8.4	9.1	9.8	10.6	81	10.3	9.4	8.7	8.0	7.3
7.9	8.5	9.2	10.0	10.8	82	10.5	9.6	8.8	8.1	7.5
8.0	8.7	9.4	10.2	11.0	83	10.7	9.8	9.0	8.3	7.6
8.2	8.9	9.6	10.4	11.3	84	11.0	10.1	9.2	8.5	7.8
8.4	9.1	9.8	10.6	11.5	85	11.2	10.3	9.4	8.7	8.0
8.6	9.3	10.0	10.8	11.7	86	11.5	10.5	9.7	8.9	8.1

Weight-for-Height Reference Card (87 cm and above)

Boys' weight (kg)					Height	Girls' weight (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Median	(cm)	Median	-1 SD	-2 SD	-3 SD	-4 SD
8.9	9.6	10.4	11.2	12.2	87	11.9	10.9	10.0	9.2	8.4
9.1	9.8	10.6	11.5	12.4	88	12.1	11.1	10.2	9.4	8.6
9.3	10.0	10.8	11.7	12.6	89	12.4	11.4	10.4	9.6	8.8
9.4	10.2	11.0	11.9	12.9	90	12.6	11.6	10.6	9.8	9.0
9.6	10.4	11.2	12.1	13.1	91	12.9	11.8	10.9	10.0	9.1
9.8	10.6	11.4	12.3	13.4	92	13.1	12.0	11.1	10.2	9.3
9.9	10.8	11.6	12.6	13.6	93	13.4	12.3	11.3	10.4	9.5
10.1	11.0	11.8	12.8	13.8	94	13.6	12.5	11.5	10.6	9.7
10.3	11.1	12.0	13.0	14.1	95	13.9	12.7	11.7	10.8	9.8
10.4	11.3	12.2	13.2	14.3	96	14.1	12.9	11.9	10.9	10.0
10.6	11.5	12.4	13.4	14.6	97	14.4	13.2	12.1	11.1	10.2
10.8	11.7	12.6	13.7	14.8	98	14.7	13.4	12.3	11.3	10.4
11.0	11.9	12.9	13.9	15.1	99	14.9	13.7	12.5	11.5	10.5
11.2	12.1	13.1	14.2	15.4	100	15.2	13.9	12.8	11.7	10.7
11.3	12.3	13.3	14.4	15.6	101	15.5	14.2	13.0	12.0	10.9
11.5	12.5	13.6	14.7	15.9	102	15.8	14.5	13.3	12.2	11.1
11.7	12.8	13.8	14.9	16.2	103	16.1	14.7	13.5	12.4	11.3
11.9	13.0	14.0	15.2	16.5	104	16.4	15.0	13.8	12.6	11.5
12.1	13.2	14.3	15.5	16.8	105	16.8	15.3	14.0	12.9	11.8
12.3	13.4	14.5	15.8	17.2	106	17.1	15.6	14.3	13.1	12.0
12.5	13.7	14.8	16.1	17.5	107	17.5	15.9	14.6	13.4	12.2
12.7	13.9	15.1	16.4	17.8	108	17.8	16.3	14.9	13.7	12.4
12.9	14.1	15.3	16.7	18.2	109	18.2	16.6	15.2	13.9	12.7
13.2	14.4	15.6	17.0	18.5	110	18.6	17.0	15.5	14.2	12.9
13.4	14.6	15.9	17.3	18.9	111	19.0	17.3	15.8	14.5	13.2
13.6	14.9	16.2	17.6	19.2	112	19.4	17.7	16.2	14.8	13.5
13.8	15.2	16.5	18.0	19.6	113	19.8	18.0	16.5	15.1	13.7
14.1	15.4	16.8	18.3	20.0	114	20.2	18.4	16.8	15.4	14.0
14.3	15.7	17.1	18.6	20.4	115	20.7	18.8	17.2	15.7	14.3
14.6	16.0	17.4	19.0	20.8	116	21.1	19.2	17.5	16.0	14.5
14.8	16.2	17.7	19.3	21.2	117	21.5	19.6	17.8	16.3	14.8
15.0	16.5	18.0	19.7	21.6	118	22.0	19.9	18.2	16.6	15.1
15.3	16.8	18.3	20.0	22.0	119	22.4	20.3	18.5	16.9	15.4
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